

PROJECT MANUAL
TECHNICAL SPECIFICATIONS

**South El Monte High School
Modernization**
South El Monte High School

South El Monte, California

El Monte Union High School District

El Monte, CA 91731

100% Construction Documents

Prepared by



DLR Group

Architecture
Engineering
Planning
Interiors

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DLR Group Project No. 75-20225-00

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Architect



Civil



Landscape Architect



Mechanical / Plumbing



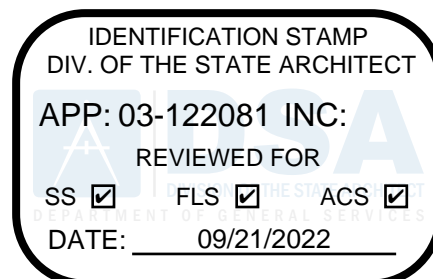
Structural



Electrical



Professional Signature



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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Phased construction.
 - 4. Owner-furnished products.
 - 5. Contractor-furnished, Owner-installed products.
 - 6. Access to site.
 - 7. Work restrictions.
 - 8. Specification and Drawing conventions.
 - 9. Miscellaneous provisions.

- B. Related Requirements:

- 1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: South El Monte High School Modernization

- 1. Project Location: 1001 Durfee Avenue, South El Monte, CA 91733.

- B. Owner: El Monte Union High School District.

- C. Architect: DLR Group.

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

- 1. Fire Alarm / Low Voltage: DCGA Engineers
 - 2. Electrical Engineer: DCGA Engineers
 - 3. Civil Engineer: SWS Engineering
 - 4. Landscape Architecture: Silverbar Studio

5. Structural Engineer: Hobach-Lewin
6. Mechanical / Plumbing Engineer: DCGA Engineers

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents.
- B. Type of Contract:
 1. Project will be constructed under a single prime contract.

1.5 PERFORMANCE REQUIREMENTS

- A. Compliance to Regulatory Requirements:
 1. California Building Standards Code (California Code of Regulations, - Title 24), Parts 1-6 and 9.
 2. Copies of Title 24. Parts 1-5 shall be kept available on-site during construction.
 3. When conflicts or inconsistencies exist between the specifications and the drawings including the general notes, the more stringent requirements shall take precedence.
 4. All Addenda must be signed by the Architect and approved by DSA (Section 4-338. Part1).
 5. All substitutions affecting DSA regulated items shall be considered a Construction Change Document (CCD) or Addenda and shall be approved by DSA prior to fabrication and installation. (IR A-6 and Section 4-338(c), Part 1).

1.6 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.
- B. Owner-Furnished Products:
 1. As indicated on drawings.

1.7 CONTRACTOR-FURNISHED, OWNER-INSTALLED PRODUCTS

- A. Contractor shall furnish products indicated. The Work includes unloading, handling, storing, and protecting Contractor-furnished products as directed and turning them over to Owner at Project closeout.
- B. Contractor-Furnished, Owner-Installed Products:
 1. As indicated on drawings.

1.8 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.9 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing buildings to normal business working hours of 7:00 a.m. to 5:30 p.m., Monday through Friday, unless otherwise indicated. The District's school calendar is posted on the District's website and is updated periodically.
 - 1. Work outside regular hours: Work outside regular working hours requires owner approval and is subject to the following restrictions:
 - a. Weekend Hours: Comply with applicable city ordinances.
 - b. Work after dark: Obtain approval from owner's representative for location of any lights that are used outside.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Restricted Substances: Use of controlled substances on Project site is not permitted.
 - 1. Smoking is not permitted within the building(s) or within 25 feet of entrances, operable windows, or outdoor-air intakes.
- F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Always require personnel to use identification tags.
- G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

1.10 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used situations. These conventions are as follows:
 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations and scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.11 INDEMNIFICATION

- A. Any contractor using these drawings or using these specifications agrees to defend, indemnify and hold harmless Architect from any claim, demand, lawsuit, cost, fees (including attorney feed), and/or liability arising from or related to the use of these drawings or specifications or the construction of the project depicted or described therein.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use facsimile of form provided in Project Manual.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication, or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size,

- durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Contractor agrees to compensate Architect, at Architect's current billing rates, for substitution requests that require modification to the contract documents. Compensation shall be made by an adjustment to the contract amount.
- a. Where required by Division of the State Architect (DSA) approvals, the Contractor shall pay all plan check fees. Or fees required to obtain approval.
 - b. The Contractor shall pay the Architect and his Consultants for all services rendered for the drawings, calculations, review time, and/or DSA plan check time for each substituted item(s) for approval.
4. Architect's Action: If necessary, Architect will request additional information or documentation for of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within a reasonable period after the Architect receives final documentation.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Substitutions may be considered when a product becomes unavailable through no fault of the Contractor. Submit requests for substitution immediately on discovery of need for change, but not later than 30 days prior to time required for preparation and review of related submittals.

- 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

- B. Substitutions for Convenience: **Requests are restricted to before bid opening.**

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 01 25 00 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

1.4 AGENCY REQUIREMENTS

- A. All addenda must be signed by the Architect and approved by DSA (Section 4-338, Part 1)

1.5 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Construction Manager will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Construction Manager are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 10 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 changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Construction Manager.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

1.6 CHANGE ORDER PROCEDURES

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

1.7 WORK CHANGE DIRECTIVE

- A. Work Change Directive: Construction Manager may issue a Work Change Directive on EJCDC Document C-940. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction 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. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect through Construction Manager at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 - 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one-line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:

- a. Project name and location.
 - b. Name of Architect.
 - c. Architect's Project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
2. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
4. 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.
5. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
6. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
7. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
8. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
9. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
10. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and Construction Manager and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use forms acceptable to Owner for Applications for Payment. Submit forms for approval with initial submittal of schedule of values.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Construction Manager 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 for work completed following previous Application for Payment, whether payment has been received. Include only amounts for work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 - 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Construction Manager by a method ensuring receipt. 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.
- 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. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Products list (preliminary if not final).
 6. Sustainable design action plans, including preliminary project materials cost data.
 7. Schedule of unit prices.
 8. Submittal schedule (preliminary if not final).
 9. List of Contractor's staff assignments.
 10. List of Contractor's principal consultants.
 11. Copies of building permits.
 12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 13. Initial progress report.
 14. Report of preconstruction conference.
 15. Certificates of insurance and insurance policies.
 16. Performance and payment bonds.
 17. Data needed to acquire Owner's insurance.
- H. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, apply 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 Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 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.
 5. AIA Document G706A.
 6. AIA Document G707.
 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 01 29 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Project meetings.
- B. Related Requirements:
 - 1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.
 - 4. Section 01 91 13 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

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

1.4 AGENCY REQUIREMENTS

- A. Title 24 Part 1-5 must be kept on site during construction.

1.5 GENERAL COORDINATION PROCEDURES

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

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities 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.
- C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the work. See other sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.

- g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
 - 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 - 2. Plenum Space: Indicate sub framing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 - 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 - 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 - 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 - 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 - 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes dimensioned from column center lines.
 - 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 - 9. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in enough scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
 - 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00 "Submittal Procedures."

- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Preparation Format: DWG, Version AutoCAD 2016, operating in Microsoft Windows operating system.
 3. File Submittal Format: Submit or post coordination drawing files using PDF format.
 4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in Revit 2016 and AutoCAD 2016.
 - c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect and Construction Manager.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
 - 1. Attachments shall be electronic files in PDF format.
- D. Architect's and Construction Manager's Action: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
 - 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 - 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect or Construction Manager of additional information.
 - 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Construction Manager in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect and Construction Manager.
 - 4. RFI number including RFIs that were returned without action or withdrawn.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's and Construction Manager'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.
- F. On receipt of Architect's and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Construction Manager within seven days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Architect's Digital Data Files: Digital data files of Architect's CAD drawings will be provided by Architect for Contractor's use during construction.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 3. Digital Drawing Software Program: Contract Drawings are available in AutoCAD 2016.
 4. Contractor shall execute a data licensing agreement in the form of AIA Document C106 Digital Data Licensing Agreement.
 - a. Subcontractors, and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of AIA Document C106.
 5. The following digital data files will be furnished for each appropriate discipline:
 - a. Floor plans.
 - b. Reflected ceiling plans.
- B. Web-Based Project Software: Use Owner's or Construction Manager's web-based Project software site for purposes of hosting and managing Project communication and documentation until Final Completion.
1. Web-based Project software site includes, at a minimum, the following features:
 - a. Compilation of Project data, including Contractor, subcontractors, Architect, architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
 - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
 - c. Document workflow planning, allowing customization of workflow between project entities.
 - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
 - e. Track status of each Project communication in real time, and log time and date when responses are provided.
 - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creating and distributing meeting minutes.
 - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
 - k. Management of construction progress photographs.
 - l. Mobile device compatibility, including smartphones and tablets.
- C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

- A. General: Construction Manager will schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Construction Manager, and Architect, within three days of the meeting.
- B. Preconstruction Conference: Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, DSA, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Sustainable design requirements.
 - o. Preparation of Record Documents.
 - p. Use of the premises and existing building.
 - q. Work restrictions.
 - r. Working hours.
 - s. Owner's occupancy requirements.
 - t. Responsibility for temporary facilities and controls.
 - u. Procedures for moisture and mold control.
 - v. Procedures for disruptions and shutdowns.
 - w. Construction waste management and recycling.
 - x. Parking availability.

- y. Office, work, and storage areas.
 - z. Equipment deliveries and priorities.
 - aa. First aid.
 - bb. Security.
 - cc. Progress cleaning.
 - 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for 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, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

- D. Project Closeout Conference: Construction Manager will schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, DSA, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.
 - d. Submittal of written warranties.
 - e. Requirements for completing sustainable design documentation.
 - f. Requirements for preparing operations and maintenance data.
 - g. Requirements for delivery of material samples, attic stock, and spare parts.
 - h. Requirements for demonstration and training.
 - i. Preparation of Contractor's punch list.
 - j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - k. Submittal procedures.
 - l. Coordination of separate contracts.
 - m. Owner's partial occupancy requirements.
 - n. Installation of Owner's furniture, fixtures, and equipment.
 - o. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Construction Manager will conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority], Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.

- b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Status of sustainable design documentation.
 - 6) Deliveries.
 - 7) Off-site fabrication.
 - 8) Access.
 - 9) Site use.
 - 10) Temporary facilities and controls.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Status of 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.
- 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Construction Manager will conduct Project coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
 - 1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority], Construction Manager, 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 meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

- c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Work hours.
 - 11) Hazards and risks.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
 - 14) Status of RFIs.
 - 15) Proposal Requests.
 - 16) Change Orders.
 - 17) Pending changes.
- 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Unusual event reports.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- 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. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
1. Working electronic copy of schedule file, where indicated.
- B. Startup construction schedule.
1. Submittal of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Material Location Reports: Submit at monthly intervals.
- G. Site Condition Reports: Submit at time of discovery of differing conditions.
- H. Unusual Event Reports: Submit at time of unusual event.
- I. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including work stages and interim milestones.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 COORDINATION

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

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Commissioning Time: Include no fewer than 15 days for commissioning.
 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use-of-premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
 - n. Commissioning.
 8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

- E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
 - 1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and the Contract Time.
- G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

1.8 STARTUP CONSTRUCTION SCHEDULE

- A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven 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 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.9 CPM SCHEDULE REQUIREMENTS

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. CPM Schedule: Prepare Contractor's Construction Schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in enough time to submit CPM schedule so it can be accepted for use no later than 60 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.
 - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.

4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- C. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- D. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediately 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.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- E. Schedule Updating: Concurrent with revising 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.
- F. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
 1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

1.10 REPORTS

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

1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Testing and inspection.
 8. Accidents.
 9. Meetings and significant decisions.
 10. Unusual events.
 11. Stoppages, delays, shortages, and losses.
 12. Meter readings and similar recordings.
 13. Emergency procedures.
 14. Orders and requests of authorities having jurisdiction.
 15. Change Orders received and implemented.
 16. Work Change Directives received and implemented.
 17. Services connected and disconnected.
 18. Equipment or system tests and startups.
 19. Partial completions and occupancies.
 20. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 32 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.

- B. Related Requirements:

- 1. Section 01 29 00 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 01 31 00 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
 - 3. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 4. Section 01 40 00 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
 - 5. Section 01 77 00 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
 - 6. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 7. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 8. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's and Construction Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals 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.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's and Construction Manager's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
1. Project name.
 2. Date.
 3. Name of Architect.
 4. Name of Construction Manager.
 5. Name of Contractor.
 6. Name of firm or entity that prepared submittal.
 7. Names of subcontractor, manufacturer, and supplier.
 8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
 9. Category and type of submittal.
 10. Submittal purpose and description.
 11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 12. Drawing number and detail references, as appropriate.
 13. Indication of full or partial submittal.

14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect and Construction Manager on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- E. Submittals for Web-Based Project Software: Prepare submittals as PDF files, or other format indicated by Project software website.

1.6 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Construction Manager's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.

2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Construction Manager, through Architect, before being returned to Contractor.
 - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect and Construction Manager.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's and Construction Manager's action stamp.
- E. 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.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's and Construction Manager's action stamp.

1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.

- c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 - 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Construction Manager, will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
 1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

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

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.8 DEFERRED APPROVALS

- A. Where shown on drawings and as specified in individual sections, submit documentation as required to obtain DSA approval of all deferred work.
- B. Architect will submit documents to DSA reviewing authority for review and comment. Architect will return documents to Contractor following DSA review.
- C. Where required, Contractor shall make all changes or corrections required by DSA reviewing authority. Contractor shall pay all fees and provide all coordination and management necessary to obtain approval, including all meeting, correspondence and communications. Once corrections are made, Contractor shall return to Architect for resubmittal.
- D. After receiving DSA final approval, Architect will furnish Contractor one complete set of DSA approved documents for Architects use in construction.

- E. Submit deferred approval documentation under the provisions of section 01 33 00 and as specified in the respective Sections.
1. Comply with the requirements of Section 4-3 17(g), Chapter 7, Part 1, title 24, CCR. All deferred approvals shall be stamped and sealed by the responsible engineer, licensed as specified. Architect will review and mark with notation indicating that the deferred submittal documents have been reviewed and that they have been found to be in general conformance with the design of the project.
 2. Submit documentation prepared under the supervision of a California licensed Engineer in the applicable discipline. All structural deferred approvals shall be prepared by California licensed Structural Engineer.
 3. Provide Deferred Approval Number and DSA Project Number and File number on the cover of each submittal.
 4. Provide document format with sufficient space for Architect and DSA agency review stamps.
 5. Clearly identify all deviations and proposed alternates to materials and systems shown on drawings and specified in the Project Manual.
 6. Drawings: Produce drawings on substantial bond paper using media of archive quality. Indicate dimensional locations of the various parts of the construction, sizes and type of members, connections, attachments, and openings.
 7. Structural Calculations: Produce calculations in booklet form, 8-112 x 11 inch size, minimum of 3 wet signed and sealed copies.
 8. Provide sufficient information with respect to design criteria, analysis methodology and material capacity to adequately evaluate documentation for compliance with applicable sections Title 24, CCR.
 9. Where required by Section 4-336, provide verified reports for work done under deferred approvals.

1.9 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.10 CONTRACTOR'S REVIEW

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

- B. Contractor's Approval: Indicate Contractor's approval for each submittal with indication in web-based Project software. Include 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.
 - 1. Architect and Construction Manager will not review submittals received from Contractor that do not have Contractor's review and approval.

1.11 ARCHITECT'S AND CONSTRUCTION MANAGER'S REVIEW

- A. Action Submittals: Architect and Construction Manager will review each submittal, indicate corrections or revisions required, and return it.
 - 1. PDF Submittals: Architect and Construction Manager will indicate, via markup on each submittal, the appropriate action.
 - 2. Submittals by Web-Based Project Software: Architect and Construction Manager will indicate, on Project software website, the appropriate action.
- B. Informational Submittals: Architect and Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect and Construction Manager will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Construction Manager.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect and Construction Manager will discard submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual 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, Commissioning Authority, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify

selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed and tested at testing facility to verify performance characteristics.
 2. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements or as part of permanent construction, consisting of multiple products, assemblies, and subassemblies.
 3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. 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.
- J. 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. Contractor's quality-control services do not include contract administration activities performed by Architect or Construction Manager.

1.4 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not enough to perform services or certification required, submit a written request for additional information to Architect.

1.5 CONFLICTING REQUIREMENTS

- A. **Conflicting Standards and Other Requirements:** If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction 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.

1.6 ACTION SUBMITTALS

- A. **Shop Drawings:** For integrated exterior mockups.
 - 1. Include plans, sections, and elevations, indicating materials and size of mockup construction.
 - 2. Indicate manufacturer and model number of individual components.
 - 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
- B. **Delegated-Design Services Submittal:** In addition to Shop Drawings, Product Data, and other required submittals, submit 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, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.7 INFORMATIONAL SUBMITTALS

- A. **Contractor's Quality-Control Plan:** For quality-assurance and quality-control activities and responsibilities.
- B. **Qualification Data:** For Contractor's quality-control personnel.
- C. **Contractor's Statement of Responsibility:** When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- D. **Testing Agency Qualifications:** For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. **Schedule of Tests and Inspections:** Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, 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.

1.8 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

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

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections including Subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

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

1.9 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, telephone number, and email address of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

1.10 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems like those indicated for this Project and with a record of successful in-service performance, as well as enough production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products like those indicated for this Project and with a record of successful in-service performance, as well as enough production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.

- b. Submit specimens in a timely manner with enough 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 and test assemblies, and mockups; do not reuse products on Project.
 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, through Construction Manager, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 - K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 1. Build mockups in location indicated or, if not indicated, as directed by Architect or Construction Manager.
 2. Notify Architect and Construction Manager seven days in advance of dates and times when mockups will be constructed.
 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 5. Obtain Architect's and Construction Manager's approval of mockups before starting corresponding work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed unless otherwise indicated.
 - L. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials. Comply with requirements in "Mockups" Paragraph.
 - M. Room Mockups: Construct room mockups according to approved Shop Drawings incorporating required materials and assemblies, finished according to requirements. Provide required lighting and additional lighting where required to enable Architect to evaluate quality of the Work. Comply with requirements in "Mockups" Paragraph.
- 1.11 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 inspection they are engaged to perform.
 2. Payment for these services will be made from testing and inspection allowances, as authorized by Change Orders.
 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Commissioning Authority, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations 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 duties of Contractor.
- E. 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 Section 013300 "Submittal Procedures."

- F. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. **Associated Contractor Services:** Cooperate with agencies and representatives 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 inspection. 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 inspection equipment at Project site.
- H. **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 inspection.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. **Schedule of Tests and Inspections:** Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update as the Work progresses.
 - 1. **Distribution:** Distribute schedule to Owner, Architect, Commissioning Authority, Construction Manager, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.12 SPECIAL TESTS AND INSPECTIONS

- A. **Special Tests and Inspections:** Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

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

1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, and Construction Manager's reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

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

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. AABC - Associated Air Balance Council; www.aabc.com.
 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 7. ABMA - American Boiler Manufacturers Association; www.abma.com.
 8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org.
 9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
 10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 11. AF&PA - American Forest & Paper Association; www.afandpa.org.
 12. AGA - American Gas Association; www.aga.org.
 13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 15. AI - Asphalt Institute; www.asphaltinstitute.org.
 16. AIA - American Institute of Architects (The); www.aia.org.
 17. AISC - American Institute of Steel Construction; www.aisc.org.
 18. AISI - American Iron and Steel Institute; www.steel.org.
 19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
 20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 21. ANSI - American National Standards Institute; www.ansi.org.
 22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
 23. APA - APA - The Engineered Wood Association; www.apawood.org.
 24. APA - Architectural Precast Association; www.archprecast.org.
 25. API - American Petroleum Institute; www.api.org.
 26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
 27. ARI - American Refrigeration Institute; (See AHRI).
 28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
 29. ASCE - American Society of Civil Engineers; www.asce.org.
 30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
 31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.

32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWP - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CE - Conformite Europeenne; <http://ec.europa.eu/growth/single-market/ce-marking/>
51. CEA - Canadian Electricity Association; www.electricity.ca.
52. CEA - Consumer Electronics Association; www.ce.org.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.pbmdf.com.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - Canadian Standards Association; www.csa.ca.
65. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
66. CSI - Construction Specifications Institute (The); www.csinet.org.
67. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
69. CWC - Composite Wood Council; (See CPA).
70. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHI - Door and Hardware Institute; www.dhi.org.
72. ECA - Electronic Components Association; (See ECIA).
73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ECIA - Electronic Components Industry Association; www.eciaonline.org.
75. EIA - Electronic Industries Alliance; (See TIA).
76. EIMA - EIFS Industry Members Association; www.eima.com.
77. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
78. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
79. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. ETL - Intertek (See Intertek); www.intertek.com.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.

82. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
85. FM Approvals - FM Approvals LLC; www.fmglobal.com.
86. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
87. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarooft.com.
88. FSA - Fluid Sealing Association; www.fluidsealing.com.
89. FSC - Forest Stewardship Council U.S.; www.fscus.org.
90. GA - Gypsum Association; www.gypsum.org.
91. GANA - Glass Association of North America; www.glasswebsite.com.
92. GS - Green Seal; www.greenseal.org.
93. HI - Hydraulic Institute; www.pumps.org.
94. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
95. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
96. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
97. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
98. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
99. IAS - International Accreditation Service; www.iasonline.org.
100. IAS - International Approval Services; (See CSA).
101. ICBO - International Conference of Building Officials; (See ICC).
102. ICC - International Code Council; www.iccsafe.org.
103. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
104. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
105. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
106. IEC - International Electrotechnical Commission; www.iec.ch.
107. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
108. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
109. IESNA - Illuminating Engineering Society of North America; (See IES).
110. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
111. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
112. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
113. ILI - Indiana Limestone Institute of America, Inc.; www.ili.ai.com.
114. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
115. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
116. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
117. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
118. ISO - International Organization for Standardization; www.iso.org.
119. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
120. ITU - International Telecommunication Union; www.itu.int/home.
121. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
122. LMA - Laminating Materials Association; (See CPA).
123. LPI - Lightning Protection Institute; www.lightning.org.
124. MBMA - Metal Building Manufacturers Association; www.mbma.com.
125. MCA - Metal Construction Association; www.metalconstruction.org.
126. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
127. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
128. MHIA - Material Handling Industry of America; www.mhia.org.
129. MIA - Marble Institute of America; www.marble-institute.com.

130. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
131. MPI - Master Painters Institute; www.paintinfo.com.
132. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
133. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
134. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
135. NADCA - National Air Duct Cleaners Association; www.nadca.com.
136. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
137. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
138. NBI - New Buildings Institute; www.newbuildings.org.
139. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
140. NCMA - National Concrete Masonry Association; www.ncma.org.
141. NEBB - National Environmental Balancing Bureau; www.nebb.org.
142. NECA - National Electrical Contractors Association; www.necanet.org.
143. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
144. NEMA - National Electrical Manufacturers Association; www.nema.org.
145. NETA - InterNational Electrical Testing Association; www.netaworld.org.
146. NFHS - National Federation of State High School Associations; www.nfhs.org.
147. NFPA - National Fire Protection Association; www.nfpa.org.
148. NFPA - NFPA International; (See NFPA).
149. NFRC - National Fenestration Rating Council; www.nfrc.org.
150. NHLA - National Hardwood Lumber Association; www.nhla.com.
151. NLGA - National Lumber Grades Authority; www.nlga.org.
152. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
153. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
154. NRCA - National Roofing Contractors Association; www.nrca.net.
155. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
156. NSF - NSF International; www.nsf.org.
157. NSPE - National Society of Professional Engineers; www.nspe.org.
158. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
159. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
160. NWFA - National Wood Flooring Association; www.nwfa.org.
161. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
162. PDI - Plumbing & Drainage Institute; www.pdionline.org.
163. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); <http://www.plasa.org>.
164. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
165. RFCI - Resilient Floor Covering Institute; www.rfci.com.
166. RIS - Redwood Inspection Service; www.redwoodinspection.com.
167. SAE - SAE International; www.sae.org.
168. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
169. SDI - Steel Deck Institute; www.sdi.org.
170. SDI - Steel Door Institute; www.steeldoor.org.
171. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
172. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
173. SIA - Security Industry Association; www.siaonline.org.
174. SJI - Steel Joist Institute; www.steeljoist.org.
175. SMA - Screen Manufacturers Association; www.smainfo.org.
176. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
177. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
178. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
179. SPIB - Southern Pine Inspection Bureau; www.spib.org.

180. SPRI - Single Ply Roofing Industry; www.spri.org.
181. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
182. SSINA - Specialty Steel Industry of North America; www.ssina.com.
183. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
184. STI - Steel Tank Institute; www.steeltank.com.
185. SWI - Steel Window Institute; www.steelwindows.com.
186. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
187. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
188. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
189. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
190. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
191. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
192. TMS - The Masonry Society; www.masonrysociety.org.
193. TPI - Truss Plate Institute; www.tpinst.org.
194. TPI - Turfgrass Producers International; www.turfgrasssod.org.
195. TRI - Tile Roofing Institute; www.tilerroofing.org.
196. UL - Underwriters Laboratories Inc.; <http://www.ul.com>.
197. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
198. USAV - USA Volleyball; www.usavolleyball.org.
199. USGBC - U.S. Green Building Council; www.usgbc.org.
200. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
201. WASTEC - Waste Equipment Technology Association; www.wastec.org.
202. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
203. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
204. WDMA - Window & Door Manufacturers Association; www.wdma.com.
205. WI - Woodwork Institute; www.wicnet.org.
206. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
207. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut für Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov/fdsys.

9. GSA - General Services Administration; www.gsa.gov.
 10. HUD - Department of Housing and Urban Development; www.hud.gov.
 11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
 12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 13. SD - Department of State; www.state.gov.
 14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
 15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
 17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
 18. USP - U.S. Pharmacopeial Convention; www.usp.org.
 19. USPS - United States Postal Service; www.usps.com.
- E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
 2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
 3. DSCC - Defense Supply Center Columbus; (See FS).
 4. FED-STD - Federal Standard; (See FS).
 5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
 6. MILSPEC - Military Specification and Standards; (See DOD).
 7. USAB - United States Access Board; www.access-board.gov.
 8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).
- F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
 2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
 3. CDHS; California Department of Health Services; (See CDPH).
 4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
 5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
 6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.

7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development;
www.txforestservation.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 01 45 29 - TESTING LAB SERVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Selection and payment.
2. Contractor submittals.
3. Laboratory responsibilities.
4. Laboratory reports.
5. Limits on testing laboratory authority
6. Contractor responsibilities.
7. Schedule of inspections and tests.

1.2 REFERENCES

- A. Title 24, CCR.
- B. ASTM D 3740 - Practice for Evaluation of Agencies in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- C. ASTM E 329 - Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

1.3 SELECTION AND PAYMENT

- A. Owner will employ and pay for services of an independent testing laboratory, approved by DSA, to perform inspection and testing as specified in this Section.
 1. Unless specified as the Owner's responsibility, all other testing, mix design preparation and related quality control and certification requirements shall be paid by the Contractor at no additional cost to Owner.
 2. All asphalt concrete mix designs shall be prepared at Contractor's cost and in compliance with Section 32 12 16.
- B. Only DSA, local legally constituted public authorities having jurisdiction over the Work, the Architect, and the Owner or their designated representatives shall be authorized to direct testing and inspection to determine compliance or non-compliance to the requirements of the Work.
 1. The Contractor shall reimburse the owner, through Contract adjustment, for inspection and testing costs caused by the following Contractor actions:
 - a. All testing costs incurred after initial test established non-conformance with contract requirements.
 - b. Inspection costs caused by Contractor's scheduling of work requiring inspections of less than 4 hours duration.

- c. Inspection costs caused by Contractor's failure to complete work requiring inspection within the scheduled duration period shown on Contractor's initial construction schedule.
- d. Inspection costs caused by Contractor's failure to order enough or required quantity of material.
- e. Inspection costs of items repaired following damage caused by Contractor.
- f. Inspection costs caused by Contractor's substitution of material, system or process, where such inspection and testing are required by the Architect, Owner or jurisdictional authority to demonstrate compliance with specified criteria.
- g. Inspection costs caused by Contractor's use of batch plant that does not comply with criteria waiving batch plant inspection.
- h. Inspection costs caused by Contractor's use of a supplier or subcontractor requiring inspection services to be performed at a location exceeding a 100-mile radius of project site.
- i. Inspection costs caused by Contractor's failure to complete work within normal hours and days, requiring overtime costs.

1.4 QUALITY ASSURANCE

- A. Laboratory: Authorized to operate in State in which Project is located, and currently approved by DSA.
- B. Laboratory Staff: Maintain a full-time registered Engineer on staff to review services.
- C. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards (NBS) Standards or accepted values of natural physical constants.
- D. Welding Inspectors shall be certified in accordance with AWS QC1 Standard for AWS Certification of Welding Inspectors.

1.5 LABORATORY RESPONSIBILITIES

- A. Perform specified inspection, sampling, and testing of Products in accordance with specified standards.
- B. Ascertain compliance of materials and mixes with requirements of Contract Documents.
- C. Promptly notify Architect of observed irregularities or non - conformance of Work or Products.
- D. Perform special inspections for areas of work as shown on drawings and specified in respective sections of the specifications in compliance with Section 4-333, Part 1, Title 24, CCR.
- E. Perform additional inspections and tests required by Architect.

1.6 LABORATORY REPORTS

- A. After each inspection and test, promptly submit copies of laboratory report to Architect, Structural Engineer, Contractor, Owner, Project Inspector, DSA, and other parties as required by referenced sections and applicable regulations.

- B. Include:
 - 1. Date issued.
 - 2. Project title, project number and DSA Application Number
 - 3. Name of inspector.
 - 4. Date and time of sampling or inspection.
 - 5. Method of obtaining sample.
 - 6. Identification of product and Specifications section.
 - 7. Location in the Project.
 - 8. Type of inspection or test.
 - 9. Date of test.
 - 10. Results of tests.
 - 11. Conformance with Contract Documents.
 - 12. Indicate samples taken but not tested.
- C. When requested by Architect, provide interpretation of test results.
- D. Testing agency shall provide verified reports in compliance with Chapter 4, Part 1, Section 4-336 DSA, of Title 24, CCR.
 - 1. Provide such reports in duplicate, on approved form.
 - 2. Provide reports each time work on the project is suspended and at completion of project.
 - 3. Reports shall document actions taken, tests made, and other aspects of the construction operations for the period prescribed.

1.7 LIMITS-ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
- B. Laboratory may not approve or accept any portion of the Work.
- C. Laboratory may not assume any duties of Contractor.
- D. Laboratory has no authority to stop the Work.

1.8 CONTRACTOR RESPONSIBILITIES

- A. Deliver or make available to laboratory at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs.
- B. Do not incorporate material or products requiring compliance with specified testing and inspection criteria without receiving documentation of compliance from approved agency.
- C. Cooperate with laboratory personnel and provide access to the Work and to manufacturer's facilities.
- D. Provide incidental labor and facilities to provide access to Work to be tested, to assist testing laboratory in obtaining and handling samples, to obtain and handle samples at the site or at source of Products to be tested, to facilitate tests and inspections, storage and curing of test samples.
 - 1. Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes.

2. Protect construction exposed by or for quality-control service activities and protect repaired construction.
 3. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.
- E. Contractor shall prepare integrated schedule for the course of construction showing all required inspection and testing. Determine the time required for the laboratory to perform testing and to issue reports and findings. Provide all required testing and inspection time within the construction schedule.
1. Notify Architect, Project Inspector and laboratory minimum two working days prior to expected time for operations requiring inspection and testing services.
 2. Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
- F. Notify the Owner's representative an enough time in advance of the manufacture or material to be supplied by Owner under the Contract Documents, which must by terms of the Contract be tested, in order that the Owner may arrange for testing at the source of supply.

1.9 SCHEDULE OF INSPECTIONS AND TESTS BY OWNER'S TESTING AGENCY

A. Site Excavation, Fills and Foundation Preparation (Title 24, Part 2)

1. All earthwork, including earth fill compaction - 1705A.6
2. Inspection of Excavation/fill Installation - 1705A.6

B. Concrete (Title 24, Part 2, Chapter 19A)

1. Materials
 - a. Portland Cement - 1705A.3, 1903A, 1913A. 1
 - b. Concrete Aggregates - 1705A.3, 1903A, 1903A.6.
 - c. Reinforcing Bars - 1705A.3, 1705A.12.1, 1903A.8, 1913A.2
 - d. Admixtures- 1903A
2. Concrete Quality
 - a. Proportions of Concrete - 1904A, 1905A. 1
 - b. Strength Tests - 1905A. 1.2, 19 13A. 1
3. Concrete Inspection
 - a. Job Site Inspection - 1705A.3.5
 - b. Batch Plant Inspection - 1705A.3.2
 - c. Waiver of Batch Plant Inspection - 1705A.3.3
 - d. Reinforcing Bar Welding Inspection - 1705A.2.2.1.2
 - e. Post-Installed Anchors in Concrete - 191 3A.7

C. Masonry (Title 24, Part 2, Chapter 21A)

1. Materials

- a. Masonry Units - 2 103A. 1
 - b. Mortar- 2 103A.9
 - c. Grout - 2103A.13
 - d. Reinforcing Bars - 2103A.14
- 2. Masonry Quality
 - a. Portland Cement Tests - 1913A. 1
 - b. Mortar and Grout Tests - 2 105A.2.2.1.4
 - c. Masonry Core Tests - 2 105A.4
 - d. Masonry Prism Tests - 2105A.2.2.2.
 - e. Masonry Unit Tests - 2105A.2.2.1.
- 3. Masonry Inspection
 - a. Reinforced Masonry - 1705A.4
 - b. Reinforcing Bar Welding Inspection - 1704A.2.2.1.2
- D. Structural Steel (Title 24, Part 2, Chapter 22A)
 - 1. Materials
 - a. Structural Steel - 2205A. 1
 - b. Cold Formed Steel 2210A
 - c. Material Identification - 2203A. 1
 - 2. Structural Steel Quality
 - a. High Strength Bolts, Nuts & Washers - 2213A.1
 - b. Tests of Structural & Cold Formed Steel - 1705A.2.2
 - c. Tests of End Welded Studs - 22 13A.2
 - 3. Structural Steel Inspection
 - a. Shop Fabrication Inspection - 1704A.2.5
 - b. High Strength Bolt Inspection - 1705A.2.1
 - c. Welding Inspection - 1705A.2.2.1, 1705A.2.2.5
 - d. Nelson Stud Welding - 22 13A.2
- E. Miscellaneous Fasteners
 - 1. Anchorage test methods as shown on drawings and specified in respective sections.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014529

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

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

1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- C. Erosion and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General permit or authorities having jurisdiction, whichever is more stringent.
- D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold.
- F. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste-handling procedures.
5. Other dust-control measures.

1.5 QUALITY ASSURANCE

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

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

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

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 enough size to accommodate needs of Owner, Architect, Construction Manager, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 2. Conference room of enough size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.
 3. Drinking water and private toilet.
 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 5. 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.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during Project.
 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- C. 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.
- D. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
1. Extent of Fence: As required to enclose entire Project site or portion determined enough to accommodate construction operations.
 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- E. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- F. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

3.4 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 3. Indicate methods to be used to avoid trapping water in finished work.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.

4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard and replace stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during construction and remain wet for 48 hours are considered defective and require replacing.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

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.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 01 25 00 "Substitution Procedures" for requests for substitutions.
 - 2. Section 01 42 00 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. If a named product or product by a named manufacturer does not meet the other requirements of the specifications, select

another named product or product from another named manufacturer that does meet the requirements of the specifications. Submit a comparable product request, if applicable.

1.4 ACTION SUBMITTALS

- A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a comparable product request. Architect will notify Contractor through Construction Manager of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Architect's Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 - 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.

e. Ratings.

3. See individual identification sections in Divisions 21, 22, 23, and 26 for additional identification requirements.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 6. Protect stored products from damage and liquids from freezing.
 7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

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

C. Submittal Time: Comply with requirements in Section 01 77 00 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

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

1. Pursuant to 40 Code of Federal Regulations 763.99(a)(7), no asbestos containing materials are allowed in any building material for the project. Contractor to provide certifications that all materials are free from any asbestos-containing building materials.
2. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
3. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
4. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
5. Where products are accompanied by the term "as selected," Architect will make selection.
6. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
7. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect through Construction Manager in order to establish equivalency of proposed products. Evaluation of "or equal" product status is by the Architect; whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase: "Subject to compliance with requirements, provide the following: ..."
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

- a. Sole manufacturer/source may be indicated by the phrase: "Subject to compliance with requirements, provide products by the following: ..."
 3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: ..."
 4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.
 - a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: ..."
 5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: ..."
 6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: ..."
 7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 25 00 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.

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

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 2. Evidence that proposed product provides specified warranty.
 3. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 4. Samples, if requested.
- B. Submittal Requirements: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for limits on use of Project site.
 - 2. Section 01 33 00 "Submittal Procedures" for submitting surveys.
 - 3. Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
 - 4. Section 02 41 19 "Selective Demolition" for demolition and removal of selected portions of the building.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
 - 1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting

and patching work. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

- a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affecting by cutting and patching operations.
2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor or professional engineer.
- B. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.
- C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 4. Dates: Indicate when cutting and patching will be performed.
 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
- D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- E. Certified Surveys: Submit two copies signed by land surveyor or professional engineer.
- F. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, fully use materials that visually match in-place adjacent surfaces possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 31 00 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect and Construction Manager promptly.
- B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect or Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Construction Manager before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points enough to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned

with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
1. Comply with Section 01 77 00 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

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

3.8 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 74 19 "Construction Waste Management and Disposal."
- 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 ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 91 13 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 01 40 00 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. Section 02 41 19 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and

demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Demolition Waste:

- a. Asphalt paving.
- b. Concrete.
- c. Concrete reinforcing steel.
- d. Brick.
- e. Concrete masonry units.
- f. Wood studs.
- g. Wood joists.
- h. Plywood and oriented strand board.
- i. Wood paneling.
- j. Wood trim.
- k. Structural and miscellaneous steel.
- l. Rough hardware.
- m. Roofing.
- n. Insulation.
- o. Doors and frames.
- p. Door hardware.
- q. Windows.
- r. Glazing.
- s. Metal studs.
- t. Gypsum board.
- u. Acoustical tile and panels.
- v. Carpet.
- w. Carpet pad.
- x. Demountable partitions.
- y. Equipment.
- z. Cabinets.
- aa. Plumbing fixtures.
- bb. Piping.
- cc. Supports and hangers.
- dd. Valves.
- ee. Sprinklers.
- ff. Mechanical equipment.
- gg. Refrigerants.
- hh. Electrical conduit.
- ii. Copper wiring.
- jj. Lighting fixtures.
- kk. Lamps.
- ll. Ballasts.
- mm. Electrical devices.

2. Construction Waste:

- a. Masonry and CMU.
- b. Lumber.
- c. Wood sheet materials.
- d. Wood trim.
- e. Metals.
- f. Roofing.
- g. Insulation.
- h. Carpet and pad.

- i. Gypsum board.
- j. Piping.
- k. Electrical conduit.
- l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Plastic pails.

1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed.

1.6 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons.
 - 4. Quantity of waste salvaged, both estimated and actual in tons.
 - 5. Quantity of waste recycled, both estimated and actual in tons.
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

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

1.7 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of waste management coordinator.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.
 - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - 5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.

3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.
- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use Form CWM-5 for construction waste and Form CWM-6 for demolition waste. Include the following:
1. Total quantity of waste.
 2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
 3. Total cost of disposal (with no waste management).
 4. Revenue from salvaged materials.
 5. Revenue from recycled materials.
 6. Savings in hauling and tipping fees by donating materials.
 7. Savings in hauling and tipping fees that are avoided.
 8. Handling and transportation costs. Include cost of collection containers for each type of waste.
 9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
1. Comply with operation, termination, and removal requirements in Section 01 50 00 "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
1. Distribute waste management plan to everyone concerned within three days of submittal return.
 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - 2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Donation: Permitted on Project site.
- C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- F. Plumbing Fixtures: Separate by type and size.
- G. Lighting Fixtures: Separate lamps by type and protect from breakage.
- H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner.

- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

- A. Asphalt Paving: Grind asphalt to maximum 4-inch size.
- B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 - 1. Pulverize concrete to maximum 4-inch size.
- D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 - 1. Pulverize masonry to maximum 4-inch size.
 - a. Crush masonry and screen to comply with requirements in Section 32 93 00 "Planting Operations" for use as mineral mulch.
 - 2. Clean and stack undamaged, whole masonry units on wood pallets.
- E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- F. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members according to size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- G. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

- H. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- I. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- J. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.
- K. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 - 1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
- L. Carpet Tile: Remove debris, trash, and adhesive.
 - 1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.
- M. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- N. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
 - a. Comply with requirements in Section 32 93 00 "Planting Operations" for use of clean sawdust as organic mulch.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
 - 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
 - a. Comply with requirements in Section 32 93 00 "Planting Operations" for use of clean ground gypsum board as inorganic soil amendment.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.
- D. Disposal: Remove waste materials and dispose of at designated spoil areas on Owner's property.
- E. Disposal: Remove waste materials from Owner's property and legally dispose of them.

3.7 ATTACHMENTS

- A. Form CWM-1 for construction waste identification.
- B. Form CWM-2 for demolition waste identification.
- C. Form CWM-3 for construction waste reduction work plan.
- D. Form CWM-4 for demolition waste reduction work plan.
- E. Form CWM-5 cost/revenue analysis of construction waste reduction work plan.
- F. Form CWM-6 cost/revenue analysis of demolition waste reduction work plan.
- G. Form CWM-7 for construction waste
- H. Form CWM-8 for demolition waste.

END OF SECTION 01 74 19

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FORM CWM-1: CONSTRUCTION WASTE IDENTIFICATION							
MATERIAL CATEGORY	GENERATION POINT	EST. QUANTITY OF MATERIALS RECEIVED* (A)	EST. WASTE - % (B)	TOTAL EST. QUANTITY OF WASTE* (C = A x B)	EST. VOLUME CY (CM)	EST. WEIGHT TONS (TONNES)	REMARKS AND ASSUMPTIONS
Packaging: Cardboard							
Packaging: Boxes							
Packaging: Plastic Sheet or Film							
Packaging: Polystyrene							
Packaging: Pallets or Skids							
Packaging: Crates							
Packaging: Paint Cans							
Packaging: Plastic Pails							
Site-Clearing Waste							
Masonry or CMU							
Lumber: Cut-Offs							
Lumber: Warped Pieces							
Plywood or OSB (scraps)							
Wood Forms							
Wood Waste Chutes							
Wood Trim (cut-offs)							
Metals							
Insulation							
Roofing							
Joint Sealant Tubes							
Gypsum Board (scraps)							
Carpet and Pad (scraps)							
Piping							
Electrical Conduit							
Other:							

* Insert units of measure.

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FORM CWM-2: DEMOLITION WASTE IDENTIFICATION

MATERIAL DESCRIPTION	EST. QUANTITY	EST. VOLUME CY (CM)	EST. WEIGHT TONS (TONNES)	REMARKS AND ASSUMPTIONS
Asphaltic Concrete Paving				
Concrete				
Brick				
CMU				
Lumber				
Plywood and OSB				
Wood Paneling				
Wood Trim				
Miscellaneous Metals				
Structural Steel				
Rough Hardware				
Insulation				
Roofing				
Doors and Frames				
Door Hardware				
Windows				
Glazing				
Acoustical Tile				
Carpet				
Carpet Pad				
Demountable Partitions				
Equipment				
Cabinets				
Plumbing Fixtures				
Piping				
Piping Supports and Hangers				
Valves				
Sprinklers				
Mechanical Equipment				
Electrical Conduit				
Copper Wiring				
Light Fixtures				
Lamps				
Lighting Ballasts				
Electrical Devices				
Switchgear and Panelboards				
Transformers				
Other:				

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FORM CWM-3: CONSTRUCTION WASTE REDUCTION WORK PLAN						
MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Packaging: Cardboard						
Packaging: Boxes						
Packaging: Plastic Sheet or Film						
Packaging: Polystyrene						
Packaging: Pallets or Skids						
Packaging: Crates						
Packaging: Paint Cans						
Packaging: Plastic Pails						
Site-Clearing Waste						
Masonry or CMU						
Lumber: Cut-Offs						
Lumber: Warped Pieces						
Plywood or OSB (scraps)						
Wood Forms						
Wood Waste Chutes						
Wood Trim (cut-offs)						
Metals						
Insulation						
Roofing						
Joint Sealant Tubes						
Gypsum Board (scraps)						
Carpet and Pad (scraps)						
Piping						
Electrical Conduit						
Other:						

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FORM CWM-4: DEMOLITION WASTE REDUCTION WORK PLAN						
MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Asphaltic Concrete Paving						
Concrete						
Brick						
CMU						
Lumber						
Plywood and OSB						
Wood Paneling						
Wood Trim						
Miscellaneous Metals						
Structural Steel						
Rough Hardware						
Insulation						
Roofing						
Doors and Frames						
Door Hardware						
Windows						
Glazing						
Acoustical Tile						
Carpet						
Carpet Pad						
Demountable Partitions						
Equipment						
Cabinets						
Plumbing Fixtures						
Piping						
Supports and Hangers						
Valves						
Sprinklers						
Mechanical Equipment						
Electrical Conduit						
Copper Wiring						
Light Fixtures						
Lamps						
Lighting Ballasts						
Electrical Devices						
Switchgear and Panelboards						
Transformers						
Other:						

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FORM CWM-5: COST/REVENUE ANALYSIS OF CONSTRUCTION WASTE REDUCTION WORK PLAN								
MATERIALS	TOTAL QUANTITY OF MATERIALS (VOL. OR WEIGHT) (A)	EST. COST OF DISPOSAL (B)	TOTAL EST. COST OF DISPOSAL (C = A x B)	REVENUE FROM SALVAGED MATERIALS (D)	REVENUE FROM RECYCLED MATERIALS (E)	LANDFILL TIPPING FEES AVOIDED (F)	HANDLING AND TRANSPORTATION COSTS AVOIDED (G)	NET COST SAVINGS OF WORK PLAN (H = D+E+F+G)
Packaging: Cardboard								
Packaging: Boxes								
Packaging: Plastic Sheet or Film								
Packaging: Polystyrene								
Packaging: Pallets or Skids								
Packaging: Crates								
Packaging: Paint Cans								
Packaging: Plastic Pails								
Site-Clearing Waste								
Masonry or CMU								
Lumber: Cut-Offs								
Lumber: Warped Pieces								
Plywood or OSB (scraps)								
Wood Forms								
Wood Waste Chutes								
Wood Trim (cut-offs)								
Metals								
Insulation								
Roofing								
Joint Sealant Tubes								
Gypsum Board (scraps)								
Carpet and Pad (scraps)								
Piping								
Electrical Conduit								
Other:								

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FORM CWM-6: COST/REVENUE ANALYSIS OF DEMOLITION WASTE REDUCTION WORK PLAN								
MATERIALS	TOTAL QUANTITY OF MATERIALS (VOL. OR WEIGHT) (A)	EST. COST OF DISPOSAL (B)	TOTAL EST. COST OF DISPOSAL (C = A x B)	REVENUE FROM SALVAGED MATERIALS (D)	REVENUE FROM RECYCLED MATERIALS (E)	LANDFILL TIPPING FEES AVOIDED (F)	HANDLING AND TRANSPORTATION COSTS AVOIDED (G)	NET COST SAVINGS OF WORK PLAN (H = D+E+F+G)
Asphaltic Concrete Paving								
Concrete								
Brick								
CMU								
Lumber								
Plywood and OSB								
Wood Paneling								
Wood Trim								
Miscellaneous Metals								
Structural Steel								
Rough Hardware								
Insulation								
Roofing								
Doors and Frames								
Door Hardware								
Windows								
Glazing								
Acoustical Tile								
Carpet								
Carpet Pad								
Demountable Partitions								
Equipment								
Cabinets								
Plumbing Fixtures								
Piping								
Supports and Hangers								
Valves								
Sprinklers								
Mech. Equipment								
Electrical Conduit								
Copper Wiring								
Light Fixtures								
Lamps								
Lighting Ballasts								
Electrical Devices								
Switchgear and Panelboards								
Transformers								

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FORM CWM-7: CONSTRUCTION WASTE REDUCTION PROGRESS REPORT

MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (TONNES) (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)		
Packaging: Cardboard								
Packaging: Boxes								
Packaging: Plastic Sheet or Film								
Packaging: Polystyrene								
Packaging: Pallets or Skids								
Packaging: Crates								
Packaging: Paint Cans								
Packaging: Plastic Pails								
Site-Clearing Waste								
Masonry or CMU								
Lumber: Cut-Offs								
Lumber: Warped Pieces								
Plywood or OSB (scraps)								
Wood Forms								
Wood Waste Chutes								
Wood Trim (cut-offs)								
Metals								
Insulation								
Roofing								
Joint Sealant Tubes								
Gypsum Board (scraps)								
Carpet and Pad (scraps)								
Piping								
Electrical Conduit								
Other:								

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FORM CWM-8: DEMOLITION WASTE REDUCTION PROGRESS REPORT								
MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (TONNES) (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)		
Asphaltic Concrete Paving								
Concrete								
Brick								
CMU								
Lumber								
Plywood and OSB								
Wood Paneling								
Wood Trim								
Miscellaneous Metals								
Structural Steel								
Rough Hardware								
Insulation								
Roofing								
Doors and Frames								
Door Hardware								
Windows								
Glazing								
Acoustical Tile								
Carpet								
Carpet Pad								
Demountable Partitions								
Equipment								
Cabinets								
Plumbing Fixtures								
Piping								
Supports and Hangers								
Valves								
Sprinklers								
Mechanical Equipment								
Electrical Conduit								
Copper Wiring								
Light Fixtures								
Lamps								
Lighting Ballasts								
Electrical Devices								
Switchgear and Panelboards								
Transformers								

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 01 78 23 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 2. Section 01 78 39 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 3. Section 01 79 00 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.

1.4 MAINTENANCE MATERIAL SUBMITTALS

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

1.5 SUBSTANTIAL COMPLETION PROCEDURES

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

- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect Construction Manager. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Construction Manager's signature for receipt of submittals.
 5. Submit testing, adjusting, and balancing records.
 6. Submit sustainable design submittals not previously submitted.
 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager 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. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.6 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 01 29 00 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
 5. Submit final completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order.
 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 and Construction Manager.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in one of the following formats:
 - a. MS Excel electronic file. Architect, through Construction Manager, will return annotated file.

- b. PDF electronic file. Architect, through Construction Manager, will return annotated file.
- c. Web-based project software upload. Utilize software feature for creating and updating list of incomplete items (punch list).

1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - 1. Submit on digital media acceptable to Architect.
- E. Warranties in Paper Form:
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- F. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
 - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - q. Leave Project clean and ready for occupancy.

- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

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

END OF SECTION 01 77 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Section 01 91 13 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

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

1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:

1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.
- D. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

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

9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. 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."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 2. 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.
 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
 2. Flood.

3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
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.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor have 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.
- C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.

6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. 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.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

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.

B. 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 warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; 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.

- a. 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.
 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.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. 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.
- G. 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.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. 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.
- J. 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 maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. 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.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. 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.
- E. 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.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 01 73 00 "Execution" for final property survey.
 - 2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
 - 3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints.
 - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Work Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
 4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Format: Annotated PDF electronic file.
 2. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

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

1.6 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- C. Format: Submit record Product Data as annotated PDF electronic file or scanned PDF electronic file(s) of marked-up paper copy of Product Data.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

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

1.8 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store record documents 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.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For facilitator and instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.

- C. Pre-construction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "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 and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - 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. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.

- f. Identification systems.
 - g. Warranties and bonds.
 - h. 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.

1.7 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. Owner will furnish Contractor with names and positions of participants.
- C. 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, , through Construction Manager, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 79 00

SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. OPR and BoD documentation are included by reference for information only.

1.2 SUMMARY

- A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- B. Related Sections:
 - 1. Section 230800 "Commissioning of HVAC" for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.

1.3 DEFINITIONS

- A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- C. CxA: Commissioning Authority.
- D. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

1.5 OWNER'S RESPONSIBILITIES

- A. Provide the OPR documentation to the CxA and Contractor for information and use.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- C. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
 1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
 3. Attend commissioning team meetings held on a monthly basis.
 4. Integrate and coordinate commissioning process activities with construction schedule.
 5. Review and accept construction checklists provided by the CxA.
 6. Complete electronic construction checklists as Work is completed and provide to the Commissioning Authority on a weekly basis.
 7. Review and accept commissioning process test procedures provided by the Commissioning Authority.
 8. Complete commissioning process test procedures.

1.7 CxA'S RESPONSIBILITIES

- A. Organize and lead the commissioning team.
- B. Provide commissioning plan.
- C. Convene commissioning team meetings.
- D. Provide Project-specific construction checklists and commissioning process test procedures.
- E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test

reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.

- F. Prepare and maintain the Issues Log.
- G. Prepare and maintain completed construction checklist log.
- H. Witness systems, assemblies, equipment, and component startup.
- I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 91 13

SECTION 02 41 19 - SELECTIVE DEMOLITION

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. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 2. Division 01 sections for cutting and patching procedures.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to a location designated by the District.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 PREDEMOLITION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

- A. Pre-demolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

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

1.9 FIELD CONDITIONS

- A. Owner will occupy portions of the campus and buildings immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials:
 - 1. Hazardous materials if present will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.

- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

- 1. Maintain fire-protection facilities and fire department access ways in service during selective demolition operations.

1.10 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.11 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.
- B. Obtain owner's approval of the selective demolition schedule prior to proceeding with the work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards:
 - 1. Comply with ASSE A10.6 and NFPA 241.
 - 2. Comply with Title 24, Part 9, California Fire Code Fire Safety.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Utilities serving the site and buildings outside of the scope of Work or phase are to be maintained in full and continuous operation unless prior written approval of the Owner is obtained.
- B. Verify that utilities have been disconnected and capped before starting selective demolition operations.

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- C. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- D. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
 - 1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
 - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building and site.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.

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- d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 sections.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

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

4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain fire watch during and for at least 72 hours after flame-cutting operations.
 6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS
- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

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

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them according to requirements in Division 01 and in a manner complying with 2016 CAL Green.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

3.8 CLEANING

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

END OF SECTION 02 41 19

SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Form-facing material for cast-in-place concrete.
 - 2. Form liners.
 - 3. Shoring, bracing, and anchoring.

- B. Related Requirements:

- 1. Section 32 16 00 "Concrete Paving" for formwork related to concrete pavement and walks.
 - 2. Section 03 30 00 "Cast In Place Concrete" for slab on-grade.

1.3 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining enough strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 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, movement, contraction, and isolation joints
 - c. Forms and form-removal limitations.
 - d. Shoring and reshoring procedures.
 - e. Anchor rod and anchorage device installation tolerances.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Forms for cylindrical columns.
4. Pan-type forms.
5. Void forms.
6. Form liners.
7. Form ties.
8. Waterstops.
9. Form-release agent.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.
 - a. Location of construction joints is subject to approval of the Architect.
3. Indicate location of water-stops.
4. Indicate form liner layout and form line termination details.
5. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
6. Indicate layout of insulating concrete forms, dimensions, course heights, form types, and details.

C. Samples:

1. For Form Liners: 12-inch by 12-inch (305-mm by 305-mm) sample, indicating texture.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing and inspection agency.

B. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC308.

C. Field quality-control reports.

D. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

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

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Form Liners: Store form liners under cover to protect from sunlight.
- B. Insulating Concrete Forms: Store forms off ground and under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
- C. Water-stops: Store water-stops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 - 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
- B. Design, engineer, erect, shore, brace, and maintain insulating concrete forms in accordance with ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design cross ties to transfer the effects of the following loads to the cast-in-place concrete core:
 - a. Wind Loads: As indicated on Drawings.
 - 1) Horizontal Deflection Limit: Not more than 1/240 of the wall height.

2.2 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:
 - 1. Provide continuous, true, and smooth concrete surfaces.
 - 2. Furnish in largest practicable sizes to minimize number of joints.
 - 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 03 30 00 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - 1) APA HDO (high-density overlay).

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- 2) APA MDO (medium-density overlay); mill-release agent treated, and edge sealed.
 - 3) APA Structural 1 Plyform, B-B or better; mill oiled, and edge sealed.
 - 4) APA Plyform Class I, B-B or better; mill oiled, and edge sealed.
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
1. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces without spiral or vertical seams not exceeding specified formwork surface class.
1. Provide forms with enough wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation, with straight end forms.
- E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally enough to support weight of plastic concrete and other superimposed loads.

2.3 WATERSTOPS

- A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.

2.4 RELATED MATERIALS

- A. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 2. Form release agent for form liners shall be acceptable to form liner manufacturer.

- F. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301 (ACI 301M).
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M) and to comply with the Surface Finish designations specified in Section 03 30 00 "Cast-In-Place Concrete" for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
 - 1. Surface Finish-1.0: ACI 117 Class D, 1 inch (25 mm).
 - 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch (6 mm).
 - 3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch (3.0 mm).
- D. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 - 1. Provide and secure units to support screed strips
 - 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

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1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches (305 mm).
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 3. Place joints perpendicular to main reinforcement.
 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 - a. 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] <Insert spacing>.
 - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 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 anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
 - 5. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
 - 1. Install in longest lengths practicable.
 - 2. Locate water stops in center of joint unless otherwise indicated on Drawings.
 - 3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
 - 4. Secure water stops in correct position at 12 inches (305 mm) on center.
 - 5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
 - a. Miter corners, intersections, and directional changes in water stops.
 - b. Align center bulbs.
 - 6. Clean water stops immediately prior to placement of concrete.
 - 7. Support and protect exposed water stop during progress of the Work.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
 - 1. Install in longest lengths practicable.
 - 2. Locate water stops in center of joint unless otherwise indicated on Drawings.
 - 3. Protect exposed water stops during progress of the Work.

3.4 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete must be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
1. Align and secure joints to avoid offsets.
 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.5 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 (ACI 318M) and ACI 301 (ACI 301M) for design, installation, and removal of shoring and reshoring.
1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over an enough story to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without enough steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.6 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. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
 2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 03 10 00

SECTION 03 20 00 - CONCRETE REINFORCING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Concrete steel reinforcement.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 45 29: Testing Lab Services.
3. Section 03 10 00: Concrete Forming and Accessories.
4. Section 03 30 00: Cast-In-Place Concrete.
5. Section 32 16 00: Concrete Paving Curbs and Walks

1.02 REGULATORY REQUIREMENTS

- ##### A. Fabrication and placement of reinforcing shall be in accordance with requirements of CBC, Chapter 19A.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A184 - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
2. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
3. ASTM A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
4. ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

B. American Concrete Institute (ACI) Publication:

1. ACI SP-66 – ACI Detailing Manual.
2. ACI 301 – Specifications for Structural Concrete.
3. ACI 318 – Building Code Requirements for Structural Concrete, as modified by CBC.

C. American Welding Society (AWS):

1. AWS D1.4 – Structural Welding Code – Reinforcing Steel.

1.04 SUBMITTALS

- A. Shop Drawings: Submit steel reinforcement Shop Drawings in accordance with ACI 315R. Include assembly diagrams, bending charts and slab plans. Indicate lengths and location of splices, size and lengths of reinforcing steel.
- B. Closeout Submittals: Record exact locations of reinforcing that vary from Shop Drawings.

1.05 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 - 1. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice.
 - 2. American Welding Society (AWS).
 - 3. American Concrete Institute (ACI).
 - 4. CBC, Chapter 19A, Concrete.
- B. Source Quality Control: Refer to Division 01 Sections for general requirements and to the following paragraphs for specific procedures. Testing laboratory retained by the OWNER shall select test Samples of bars, ties, and stirrups from the material at the Project Site or from the place of distribution, with each Sample consisting of not less than two 18 inch long pieces, and perform the following tests according to ASTM A615, or ASTM A706, as applicable:
 - 1. Identified Bars: If Samples are obtained from bundles as delivered from the mill, identified as to heat number, accompanied by mill analyses and mill test reports, and properly tagged with the identification certificate so as to be readily identified, perform one tensile and one bend test for each 10 tons or fraction thereof of each size of bars. Submit mill reports when Samples are selected.
 - 2. Unidentified Bars: When positive identification of reinforcing bars cannot be performed and when random Samples are obtained; perform tests for each 2.5 tons or fraction thereof, one tensile and one bend test from each size of bars.
- C. Certification of Welders: Shop and Project site welding shall be performed by welding operators certified by AWS.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Avoid exposure to dirt, moisture or conditions harmful to reinforcing.
- B. Reinforcing steel bars, wire, and wire fabric shall be stored on the Project site to permit easy access for examination and identification of each shipment. Material of each shipment shall be separated for size and shape.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Provide reinforcing of sizes, gages and lengths indicated, bent to indicated shapes.

2.02 MATERIALS

- A. Steel Reinforcing Bars: ASTM A615, or ASTM A706 deformed grade 60 billet steel unless otherwise specified or indicated.
- B. Bars or Rod Mats: ASTM A184.

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- C. Welded Wire Fabric for Reinforcement: ASTM A1064.
- D. Tie Wire: ASTM A1064, fully annealed, copper-bearing steel wire, 16 gauge minimum.
- E. Chairs, Spacers, Supports, and Other Accessories: Standard manufacture conforming to ACI 315R fabricated from steel wire of required types and sizes. For reinforcement supported from grade, provide properly sized dense precast blocks of concrete.

2.03 FABRICATION OF REINFORCING BARS

- A. Comply with CRSI Manual of Standard Practice for Reinforced Concrete Construction for fabrication of reinforcing steel.
- B. Bending and Forming: Fabricate bars of the indicated sizes and bend and form to required shapes and lengths by methods not injurious to materials. Do not heat reinforcement for bending. Bend bars No. 6 size and larger in the shop only. Bars with unscheduled kinks or bends are not permitted. Provide only tested and permitted bar materials.
- C. Welding: Provide only ASTM A706 steel where welding is indicated. Perform welding by the direct electric arc process in accordance with AWS D1.4 and specified low-hydrogen electrodes. Preheat 6 inches each side of joint. Protect joints from drafts during the cooling process; accelerated cooling is not permitted. Do not tack weld bars. Clean metal surfaces to be welded of loose scale and foreign material. Clean welds each time electrode is changed, and chip burned edges before placing welds. When wire brushed, the completed welds must exhibit uniform section, smooth welded metal, feather edges without undercuts or overlays, freedom from porosity and clinkers, and good fusion and penetration into the base metal. Cut out welds or parts of welds deemed defective, using chisel, and replace with proper welding. Prequalification of welds shall be in accordance with CBC requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Bars shall be bent cold. Bars partially embedded in concrete shall not be field bent except as indicated on reviewed Shop Drawings.
- B. Before installation and just prior to placing concrete, clean reinforcing of loose scale, rust, oil, dirt and any coating that could reduce bond.
- C. Accurately position, install, and secure reinforcing to prevent displacement during the placement of concrete.
- D. Provide metal chairs to hold reinforcement the required distance above form bottoms. In beams and slab construction, provide chairs under top slab reinforcement as well as under bottom reinforcement. Space chairs so that reinforcement will not be displaced during installation. Provide metal spacers to secure proper spacing. Stirrups shall be accurately and securely wired to bars at both top and bottom. At slabs, footings, and beams in contact with earth, provide concrete blocks to support reinforcement at required distance above grade.
- E. Install and secure reinforcement to maintain required clearance between parallel bars and between bars and forms. Lapped splices shall be installed wherever possible in a manner to provide required clearance between sets of bars. Stagger lapped splices. Dowels and

bars extending through construction joints shall be secured in position against displacement before concrete is installed and subsequently cleaned of concrete encrustations while they are still soft.

- F. Do not install reinforcing in supported slabs and beams until walls and columns have been installed to underside of slabs and beams or until construction joints have been thoroughly cleaned. Reinforcing shall be inspected before placement of concrete and cleaned as required.
- G. Use deformed bars unless otherwise indicated.

3.02 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

3.03 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION 03 20 00

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Retaining and Freestanding Walls.
 - 4. Slabs-on-grade.
 - 5. Slab substrate.
- B. Related Sections include the following:
 - 1. Division 03 Section "Architectural Concrete" for general building applications of specially finished formed concrete.
 - 2. Division 07 Section "Reinforced Vapor Retarder for under slabs".
 - 3. Division 09 Section "Tiling for finish of concrete floor tiling.
 - 4. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.
 - 5. Division 32 Section "Concrete Paving" for concrete pavement and walks.
 - 6. Division 32 Section "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.03 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments. Design mixtures shall be prepared by and signed and sealed by a Registered Civil Engineer.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Samples: For vapor retarder.

- E. Qualification Data: For Installer.
 - F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
 - a) Material Certificates: For each of the following, signed by manufacturers:
 - 2. Cementitious materials.
 - 3. Admixtures.
 - 4. Form materials and form-release agents.
 - 5. Steel reinforcement and accessories.
 - 6. Granular fill.
 - 7. Curing compounds.
 - 8. Floor and slab treatments.
 - 9. Bonding agents.
 - 10. Adhesives.
 - 11. Semirigid joint filler.
 - 12. Joint-filler strips.
 - 13. Repair materials.
 - G. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
 - H. Field quality-control test and inspection reports. (By I.O.R. and Testing Agency).
- 1.05 QUALITY ASSURANCE
- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
 - B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
 - C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency

laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code-Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5 and Section 7, "Lightweight Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.
 - 1. Build panel approximately 200 sq. ft. (18.6 sq. m) for slab-on-grade and 100 sq. ft. (9.3 sq. m) for formed surface in the location indicated or, if not indicated, as directed by Architect.
 - 2. Approved panels may become part of the completed Work if undisturbed at time of Substantial Completion.
- I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

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1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints. Refer to Section 03 35 00 for form facing materials for colored architectural concrete.
 1. Plywood, metal, or other approved panel materials.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.03 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Plain-Steel Wire: ASTM A 82, as drawn.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.04 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 2. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.05 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 1. Portland Cement: ASTM C 150, Type II, gray Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. Use ASTM C227 to determine alkali reactivity of the aggregates as specified therein. The alkali reactivity shall be "innocuous" as determined by ASTM C289.
 1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Water: ASTM C 94/C 94M and potable.

2.06 ADMIXTURES

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

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- C. Color Pigment: Refer to Section 03 35 00 Colored Architectural Concrete. Add other admixtures, such as integral waterproofing admixtures, if required.

2.07 GRANULAR FILL

- A. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, with 90 to 100 percent passing a $\frac{3}{4}$ sieve; 0 to 10 percent passing a No. 4 sieve; and 0 to 3 percent passing a No. 100 sieve.
- B. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a $\frac{3}{8}$ -inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.08 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet. USE FOR ALL FLATWORK, SLABS AND TOPPINGS.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
1. Products:
 - a. Anti-Hydro International, Inc.; AH Clear Cure WB.
 - b. Burke by Edoco; Spartan Cote WB II.
 - c. ChemMasters; Safe-Cure & Seal 20.
 - d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Cure and Seal WB.
 - e. Dayton Superior Corporation; Safe Cure and Seal (J-18).
 - f. Euclid Chemical Company (The); Aqua Cure VOX.
 - g. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
 - h. Lambert Corporation; Glazecote Sealer-20.
 - i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
 - j. Meadows, W. R., Inc.; Vocomp-20.

- k. Metalcrete Industries; Metcure.
- l. Nox-Crete Products Group, Kinsman Corporation; Cure & Seal 150E.
- m. Symons Corporation, a Dayton Superior Company; Cure & Seal 18 Percent E.
- n. Tamms Industries, Inc.; Clearseal WB 150.
- o. Unitex; Hydro Seal.
- p. US Mix Products Company; US Spec Hydrasheen 15 percent

2.09 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Reglets: Fabricate reglets of not less than 0.0217-inch- (0.55-mm-) thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

2.010 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4500 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 4500 psi at 28 days when tested according to ASTM C 109/C 109M.

2.011 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 15 percent.
 - 2. Combined Fly Ash and Pozzolan: 15 percent.
 - 3. Comply with CBC Section 1903A.5.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup. See Section 03 35 00 for other details.

2.012 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: As indicated on the Drawings.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.50.
 - 3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
- B. Foundation Walls: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: As indicated on the Drawings.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.50.
 - 3. Slump Limit: 5 inches (125 mm), plus or minus 1 inch (25 mm).
- C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: As indicated on the Drawings.
 - 2. Minimum Cementitious Materials Content: 610 lb/cu. yd. (320 kg/cu. m).
 - 3. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 4. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).

5. Build (3) 4-foot square mock-up panels for Architect's approval.

D. Concrete Toppings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As indicated on the Drawings.
2. Minimum Cementitious Materials Content: 610 lb/cu. yd. (320 kg/cu. m).
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).

E. Retaining and Freestanding Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As indicated on the Drawings.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Slump Limit: 5 inches (125 mm), plus or minus 1 inch (25 mm).

2.013 FABRICATING REINFORCEMENT

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

2.014 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
 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

3.01 FORMWORK

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

CAST-IN-PLACE CONCRETE

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1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 EMBEDDED ITEMS

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

3.03 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 48 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.04 SHORES AND RESHORES

- A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.
1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.05 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
- B. Granular Course: Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus 3/4 inch (19 mm).
1. Place and compact a 1/2-inch- (13-mm-) thick layer of fine-graded granular material over granular fill.

3.06 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.07 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls practical. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. 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.

3.08 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing 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. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
- 3.09 FINISHING FORMED SURFACES
- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.

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

3.010 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in 1 direction.
 - 1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of

trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 - b. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
 - c. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
 - d. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.
3. Finish and measure surface with a dipstick measuring device by Face Construction Technologies or a F-meter measuring device by Allen Face & Company.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom. Coordinate finish with Section 093000 "Tiling".
 1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.011 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.012 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Use only this method for slabs, concrete fill and toppings. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.013 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions. Refer to Section 033300 for other details.
 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than seven days old.
 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.014 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.015 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match

before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.016 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a resident inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Section 014523.

END OF SECTION 03 30 00

CAST-IN-PLACE CONCRETE

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SECTION 03 35 00 – CONCRETE FLOOR FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Finishing of concrete slabs.
 - 2. Surface treatment with concrete combination hardener/sealer at all exposed concrete floors.
- B. Related Sections:
 - 1. Section 03 30 00 Cast in Place Concrete.

1.3 REFERENCE STANDARDS

- A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.
- B. ACI 117-90, ACI 302.1R and ASTM E1155 - Determining Floor Flatness and Floor Levelness using the F Number System.
- C. Local AQMD Air Quality Management District.
- D. ASTM C779.
- E. ADA - Americans with Disabilities Act of 1990, as amended
 - 1. ADA Standards - ADA Title II Regulations and the 2010 ADA Standards for Accessible Design.

1.4 PREINSTALLATION MEETINGS

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

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

- B. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.
- C. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- D. Material Test Reports: For each flooring system, by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For flooring to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during flooring application and for 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 FINISHES

- A. Combination Hardener and Sealer: ASTM C779.
 - 1. ASHFORD FORMULA by Curecrete Chemical Co., Springville, UT.
 - 2. SHUR-SEAL by Paul M. Wolff Co, Orange, CA.

CONCRETE FLOOR FINISHING

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3. Chemprobe CT Densifier 629 by Tnemec Company.
4. LIQUI-HARD by W.R. Meadows.
5. Or equal in accordance with Division 01 for Substitutions.
6. Remove all curing compounds before installation.

- B. Combination Hardener, and Sealer: ASTM C779, Ashford Formula by Curecrete Chemical Co., Springville, UT; Shure-Seal by Paul M. Wolff Co., Orange, CA; Chemprobe CT Densifier 629 by Tnemec Company; LIQUI-HARD by W.R. Meadows, or equal.

2.2 REGULATORY REQUIREMENTS

- A. Slip Resistant: Surfaces shall be stable, firm and slip resistant compliant with CBC 11B-302.1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify site conditions.
- B. Verify that floor surfaces are acceptable to receive Work of this Section.
- C. Commencement of Work means acceptance of existing conditions.
- D. Remove all curing compounds before installation.

3.2 FLOOR FINISHING

- A. Comply with recommendations in ACI 302.1R for screeding, floating, straight edging, restraighening (with Modified Highway Straightedge) operations and troweling and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if areas are small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth granular texture.
- C. Trowel Finish: After float finish, minimum 2 trowel operations, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue trowel passes and restraighening (with Modified Highway Straightedge) operations until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
- D. Install concrete floors and slabs in Levelness and Flatness in accordance with ASTM E1155, random traffic floors, and the following below: (SOV = Specified Overall Value and MLV = Minimum Local Value)
 1. Finish floor slabs: FF = 35 and FL = 25 SOV; FF = 24 MLV and FL = 17 MLV for slabs-on-grade.
 2. Finish floors slab on grade: FF = 45 and FL = 35 SOV; FF = 30 and FL = 24 MLV; for and treated Exposed Concrete Floors.

CONCRETE FLOOR FINISHING

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3. Finish floor slabs: FF = 20 and FL = 15 SOV; FF = 14 MLV and FL = 10 MLV; to receive concrete floor toppings, mortar setting beds for tile, bonded applied cementitious finish flooring material.
- E. Steel trowel surfaces that will receive carpeting, resilient flooring, thinset ceramic tile, thin set quarry tile, floor sealer or elastomeric coatings, minimum of two trowelings.
 1. Exposed concrete surfaces with hardener/sealer: slip resistant surface. Static Coefficient of Friction: ASTM D2047, minimum 0.6 COF for level surface conditions, CBC 11B-302.
 2. Surfaces scheduled to receive elastomeric coatings: Fine-hair broom surface.
- F. Steel trowel surfaces scheduled to be exposed.
- G. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains.

3.3 FLOOR SURFACE TREATMENT

- A. Apply combination hardener and sealer to interior concrete slab surfaces as scheduled in accordance with manufacturer's instructions. Apply minimum two coats after first coat is dry and acceptable to manufacturer.
 1. For Wet Concrete:
 - a. Apply hardener sealer per manufacturer's instructions immediately following the finishing operations and as soon as surface is firm enough to walk on.
 - b. Keep the entire surface wet with hardener and sealer for 30 minutes.
 - c. Lightly mist the surface with water when hardener sealer begins to dry and becomes slippery,
 - d. As hardener-sealer begins to dry into the surface and becomes slippery underfoot, flush the surface with water and squeegee surface totally dry to remove any excess material.
 2. For Cured Concrete:
 - a. Thoroughly clean surfaces sweep areas to be treated with fine bristle broom. Hose floor to remove dust and dirt.
 - b. Clean concrete surfaces with manufacturer's recommended remover.
 - c. Apply material to dry surfaces or damp per manufacturer's instructions. Dispose of standing puddles.
 - d. Uniformly distribute material at a minimum rate of 200 square feet per gallon.

3.4 FIELD QUALITY CONTROL

- A. Measure floor and slab Flatness (FF) and Levelness (FL) according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing or slabs on grade and before removal of shoring and forms for suspended slabs.
- B. Repair for slabs-on-grade failing to meet specified tolerances (out-of-tolerance): surface repair, grinding, planing, retopping, cementitious self-leveling underlayment; at no additional cost to the Owner.

3.5 PROTECTION

- A. Protect treated concrete surfaces from damage by construction activities with durable temporary coverings offering floor protection until acceptance by the Architect. Damaged to floor finishes shall be repaired by the Contractor at no cost to the Owner.
- B. Flooring shall be protected as follows:
 - 1. Protect entire floor where area anticipated to be affected. Submit layout of protected area to Architect for approval.
 - 2. Loose lay rosin-sized building paper over floor area; tape all seams; do not tape or otherwise attach to floor.
 - 3. Over building paper, loose lay 10 mil polyethylene sheets; tape all seams. Do not tape or otherwise attach to floor.
 - 4. Take other precautions as necessary to prevent damage in addition to requirements above. Submit to Architect for approval.

END OF SECTION 03 35 00

SECTION 04 22 00 - CONCRETE MASONRY UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 01 Specification Sections, Drawings, General Conditions, Supplementary General Conditions, and Special Conditions apply to this section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units (CMU).
 - 2. Mortar and grout.
 - 3. Reinforcing steel.
 - 4. Control joint materials.
 - 5. Masonry joint reinforcement.
 - 6. Ties and anchors.
 - 7. Embedded flashing.
 - 8. Miscellaneous masonry accessories.

1.03 SUBMITTALS

- A. Certificates of compliance with respective ASTM standards shall be submitted on all products specified herein.
 - 1. Concrete masonry units.
 - 2. Spec Mix preblended mortar: Include test report or batch data for verification of proportions of materials.
 - 3. Grout: Include mix design for verification of proportions of materials.
 - 4. Steel reinforcing bars.
 - 5. Preformed control joint gaskets.
- B. Samples for Verification: For each type and color of the following:
 - 1. Exposed concrete masonry units.
 - 2. Mortar, for color selection or confirmation.

1.04 QUALITY ASSURANCE

- A. Preconstruction Testing.
 - 1. Owner will select a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner.
 - 2. The compressive strength of masonry shall be determined based on strength of the unit and type of mortar specified (Unit Strength Method) per CBC Table 2105.2.2.1.2 (ACI 530.1/ASCE 6/TMS 602 Table 2).

- a. Concrete Masonry Units: Test per ASTM C 140.
 - b. Grout: Test per ASTM C 1019.
 - 3. Mortar and grout tests: At beginning of work, sample mortar and grout on three successive working days per CBC Section 2105A.5.
 - B. Sample Panels: Construct an approximate long by panel for representation of completed masonry, joint tooling, design details, and workmanship. Comply with requirements in Division 01 Section "Quality Requirements" for mockups.
- 1.05 DELIVERY, STORAGE, AND HANDLING
- A. All materials of this section shall be protected to maintain quality and physical requirements.
 - B. All masonry units shall be stored on the jobsite so that they are protected from rain, stored off-ground and kept clean from contamination. Prevent units from being otherwise wetted.
 - C. Store Spec Mix preblended mortar mix in manufacturer's original, unopened, undamaged containers with identification labels intact, covered and protected from weather, or in a Spec Mix dispensing silo.
- 1.06 FIELD CONDITIONS
- A. Securely cover tops of all unsheltered walls and partially completed walls when work is not in progress.
 - B. Cold-weather procedures when ambient temperature falls below 40°F (4°C) or the temperature of masonry units is below 40°F (4°C):
 - 1. Wet or frozen units shall not be laid.
 - 2. Implement cold weather construction procedures in accordance with IBC Section 2104.3.
 - C. Hot-weather procedures when ambient temperature exceeds 100°F (38°C), or exceeds 90°F(32°C) with a wind velocity greater than 8 mph:
 - 1. Implement hot weather construction procedures in accordance with IBC Section 2104.4.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Concrete masonry units.
 - 1. Angelus Block Co., Inc.
 - a. Sun Valley, CA (818) 767-8576
 - b. Orange, CA (714) 637-8594
 - c. Fontana, CA (909) 350-0244
 - d. Gardena, CA (310) 323-8841
 - e. Oxnard, CA (805) 485-1137
 - f. Indio, CA (760) 347-3245
- B. Preblended mortar.
 - 1. Spec Mix Preblended Mortar Mix, by E-Z Mix, Inc.

2.02 MASONRY PERFORMANCE REQUIREMENTS

- A. Provide materials to achieve the net compressive strength of concrete unit masonry equal to or greater than 2000 psi f'_m .
- B. Provide materials to achieve the net compressive strength of concrete unit masonry equal to or greater than the f'_m as indicated .

2.03 CONCRETE MASONRY UNITS

- A. Concrete Masonry Units: ASTM C 90.
 - 1. Weight Classification: Medium weight unless otherwise indicated.
 - 2. Color(s) and texture(s):
 - a. Grey

2.04 MORTAR AND GROUT MATERIALS

- A. Spec Mix Masonry Mortar preblended factory mix: ASTM C 270, proportions.
 - 1. Portland cement: ASTM C 150
 - 2. Hydrated lime: ASTM C 207
 - 3. Aggregate for mortar: ASTM C 144.
 - 4. 28-day strength: 2,000 psi minimum.
- B. Grout:
 - 1. Portland cement: ASTM C 150
 - 2. Aggregate: ASTM C 404.
 - 3. Fly ash: ASTM C 618.
 - 4. 28-day strength: 2,000 psi minimum.
- C. Water: Potable.
- D. Admixtures:
 - 1. The use of admixtures shall not be permitted except as specified herein, or as approved by the Architect or Engineer of Record and the Building Official.
 - 2. PRE-MIX Products Grout Additive manufactured by E-Z Mix, Inc. Use per manufacturer's specifications.

2.05 REINFORCEMENT

- A. Steel Reinforcing Bars: ASTM A 615, Grade 60.
- B. Masonry Joint Reinforcement: ASTM A 951.
 - 1. Masonry joint reinforcement used in exterior walls shall be hot-dipped galvanized.

2.06 TIES AND ANCHORS

- A. Metal ties and anchors shall meet the requirements of CBC Section 2103.13.

2.07 MISCELLANEOUS MASONRY ACCESSORIES

- A. PVC Preformed Control-Joint Gaskets: per ASTM D 2287, Type PVC.
- B. Rubber Preformed Control-Joint Gaskets: per ASTM D 2000, Designation M2AA-805.

2.08 MORTAR AND GROUT MIXES

- A. Type S Spec Mix Preblended, Dry Mortar Mix.
 - 1. Complies with ASTM C 270 Proportion Specification.
 - 2. Natural gray color.
- B. Grout for Unit Masonry: per ASTM C 476.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to the start of masonry installation, verify all conditions pertinent to the performance of work in this Section are acceptable.
 - 1. Foundation shall be level and at correct grade such that the initial bed joint shall not be less than 1/4 inch nor more than 3/4 inch.
 - 2. Verify that reinforcing dowels are properly placed.
- B. Masonry work shall not proceed until unsatisfactory conditions have been corrected or cleared by the governing authority.

3.02 INSTALLATION

- A. Cut units as required to fit; use motor-driven masonry saw. Install cut units with cut surfaces edges concealed as much as possible.
- B. Lay dry units only, unless otherwise approved.
- C. Select and arrange units for exposed masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.
- D. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602.

3.03 LAYING MASONRY WALLS

- A. All masonry shall be laid true, level, plumb, and in accordance with the drawings.
- B. Masonry shall be laid in running bond unless otherwise indicated.
- C. Exposed masonry shall be laid in running bond unless otherwise indicated.
- D. Concealed masonry shall be laid in running bond unless otherwise indicated.
- E. Install built-in items specified in this and other Sections as work progresses. Solid grout all spaces around built-in items unless otherwise noted on the drawings.

3.04 MORTAR BEDDING AND JOINTING

- A. Lay hollow units with head and bed joints filled with mortar for the thickness of the face shell.
- B. Lay solid units with full head and bed joints. Do not fill head joints by slushing with mortar. Bed joints shall not be furrowed deep enough to produce voids.
- C. All mortar joints on exposed walls shall be concave, unless otherwise indicated, and struck to produce a dense, slightly concave surface well bonded to the surface of the masonry unit.
- D. Cut joints flush for masonry walls to receive plaster, unless otherwise indicated.
- E. Thickness of bed joints shall not exceed 5/8 inch.

3.05 MASONRY JOINT REINFORCEMENT

- A. Embed joint reinforcement with minimum 5/8 inch cover to exposed face, and 1/2 inch elsewhere.

3.06 CONTROL AND EXPANSION JOINTS

- A. Construct control joints as detailed in the drawings as masonry progresses.
 - 1. Install preformed control-joint gaskets designed to fit standard sash block.

3.07 INSTALLATION OF REINFORCING STEEL

- A. Place reinforcement as detailed on the drawings.
 - 1. Maintain clear distances between reinforcement and masonry, and maintain placement tolerances in compliance with requirements in ACI 530.1/ASCE 6/TMS 602.

3.08 GROUTING

- A. Comply with grout placement requirements in ACI 530.1/ASCE 6/TMS 602.

3.09 FIELD QUALITY CONTROL

- A. Inspection tasks and frequency shall be performed in accordance with the Statement of Special Inspections.
- B. Unless indicated otherwise, perform one set of tests for each 5000 sq. ft. of wall area or portion thereof.
- C. Concrete Masonry Units: test per ASTM C 140.
- D. Grout: Test per ASTM C 1019.
- E. Prism Test: For each type of construction indicated, construct and test three prisms per ASTM C 1314 at 28 days.
- F. Masonry Core Test: Core and test per CBC Section 2105.4 from locations selected by the Design Professional.
- G. Mortar and grout tests: Sample mortar and grout at minimum one-week intervals per CBC Section 2105.5.

3.010 POINTING, AND CLEANING

- A. Point and tool holes in mortar joints to produce a uniform, tight joint.
- B. During construction, minimize any mortar or grout stains on the wall. Immediately remove any staining or soiling that occurs.
 - 1. For precision or textured units, except as noted below, clean masonry by dry brushing before tooling joints.
 - 2. For burnished concrete masonry units, immediately remove any green mortar smears or soiling with a damp sponge
- C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Clean exposed cmu walls with a light sandblast. All non-masonry work near the area to be sandblasted shall be covered or protected before the sandblasting starts. Care shall be taken to avoid contamination to areas that are not to be sandblasted.
 - a. Glazed, burnished, or pre-finished masonry units, shall be protected from sandblast operations.

- D. At completion of masonry work, remove all scaffolding and equipment used during construction, and remove all debris, refuse, and surplus masonry material from the site.

END OF SECTION

SECTION 05 12 00 – STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Structural steel.
2. Grout.

B. Related Sections:

1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 05 Section "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
3. Division 05 Section "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications and other metal items not defined as structural steel.
4. Division 09 painting Sections and Division 09 Section "High-Performance Coatings" for surface-preparation and priming requirements.

1.03 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- 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 A 6/A 6M with flanges thicker than 1-1/2 inches (38 mm).
 2. Welded built-up members with plates thicker than 2 inches (50 mm).
 3. Column base plates thicker than 2 inches (50 mm).
- 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.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 - 5. Identify members and connections of the seismic-load-resisting system.
 - 6. Indicate locations and dimensions of protected zones.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," 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.
 - 3. Preheat and interpass temperatures.
- D. Qualification Data: For qualified Installer and fabricator.
- E. Welding certificates.
- F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- G. Mill test reports for structural steel, including chemical and physical properties.
- H. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength bolt-nut-washer assemblies.
 - 4. Shear stud connectors.
 - 5. Shop primers.
 - 6. Non-shrink grout.
- I. Source quality-control reports.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that is licensed as a Los Angeles City Department of Building Safety Approved Fabricator or equal.
- B. Installer Qualifications: A qualified installer that is licensed in the State of California and has a minimum of five (5) years of experience.

- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
 - D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
 - E. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 341 and AISC 341s1.
 - 3. AISC 360.
 - 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - F. Preinstallation Conference: Conduct conference at Project site.
- 1.06 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 F 1852 fasteners and for retesting fasteners after lubrication.

1.07 COORDINATION

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

PART 2 - PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

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

- B. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
 - 1. W-Shapes: 60 percent.
 - 2. Channels, Angles, Shapes: 60 percent.
 - 3. Plate and Bar: 25 percent.
 - 4. Cold-Formed Hollow Structural Sections: 25 percent.
 - 5. Steel Pipe: 25 percent.
 - 6. All Other Steel Materials: 25 percent.
- C. W-Shapes: ASTM A 992/A 992M.
- D. Channels, Angles, Shapes: ASTM A 36/A 36M.
- E. Plate and Bar: ASTM A 36/A 36M.
- F. Gusset Plates used on Braced Frames: ASTM A572, Grade 50.
- G. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- H. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
 - 1. Weight Class: As indicated on the Drawings.
 - 2. Finish: Black except where indicated to be galvanized.
- I. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.
- J. Steel Forgings: ASTM A 668/A 668M.
- K. Welding Electrodes: Comply with AWS requirements. Electrodes shall be E70 Series and shall meet a Charpy V-Notch Impact Energy of 20 Ft-Lbs. at -20°F.

2.02 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
- B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip or mechanically deposited zinc coating.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with mechanically deposited zinc coating finish.
- C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain.

- D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- E. Unheaded Anchor Rods: ASTM F 1554, Grade as indicated on the Drawings.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
 - 5. Finish: Plain.
- F. Headed Anchor Rods: ASTM F 1554, Grade as indicated on the Drawings.
 - 1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 - 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
 - 4. Finish: Plain.
- G. Threaded Rods: ASTM A 36/A 36M.
 - 1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 - 2. Washers: ASTM A 36/A 36M carbon steel.
 - 3. Finish: Plain.
- H. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
- I. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
 - 1. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.03 PRIMER

- A. Primer: High solids, single component rust-inhibitive alkyd primer.
- B. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.04 GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, 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 C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.05 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.

3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel 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 according to SSPC-SP 2, "Hand Tool Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing 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.

2.06 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Slip critical.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, preheating, post-weld cooling and methods used in correcting welding work.
 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.
 2. Preheat and interpass temperatures shall conform to Table 3.2 of AWS D1.1.

2.07 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 2. Surfaces to be field welded.
 3. Surfaces to be high-strength bolted with slip-critical connections.

4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
1. SSPC-SP 2, "Hand Tool Cleaning."
 2. SSPC-SP 3, "Power Tool Cleaning."
 3. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
 5. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
 6. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 7. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
 8. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
 9. SSPC-SP 8, "Pickling."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.08 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
 2. Galvanize lintels, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.

2.09 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

3.03 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Base Bearing 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 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 shrinkage-resistant grouts.
 - C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure.
 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.
 - H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- 3.04 FIELD CONNECTIONS
- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Slip critical.
 - B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
 4. Comply with AWS D1.1, Table 3.2 for preheat and interpass temperatures.
- 3.05 FIELD QUALITY CONTROL
- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections. See Section 014523.
 - B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.06 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

END OF SECTION 05 12 00

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Roof deck.
 - 2. Composite floor and roof deck.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for concrete fill.
 - 2. Division 05 Section "Structural Steel Framing" for shop- and field-welded shear connectors.
 - 3. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
 - 4. Division 09 Section "Interior Painting"

1.03 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
- C. Product Certificates: For each type of steel deck, signed by product manufacturer.
- D. Welding certificates.
- E. Field quality-control test and inspection reports.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.
 - 2. Acoustical roof deck.
- G. Research/Evaluation Reports: For steel deck.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.
- B. Source Limitations for Electrified Cellular Floor Deck: Obtain cellular floor-deck units and compatible electrical components, such as preset inserts, activation kits, afterset inserts, service fittings, header ducts, and trench header ducts, from same manufacturer.

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- C. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
 - D. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those 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 of applicable testing and inspecting agency.
 - 2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.
 - E. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
 - F. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- 1.05 DELIVERY, STORAGE, AND HANDLING
- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
 - B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
 - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.
- 1.06 COORDINATION
- A. Coordinate installation of sound-absorbing insulation strips in topside ribs of acoustical deck with roofing installation specified in Division 07 to ensure protection of insulation strips against damage from effects of weather and other causes.
 - B. Coordinate layout and installation of trench headers, preset inserts, duct fittings, and other components specified in Division 26 Section "Underfloor Raceways for Electrical Systems" with installation of electrified cellular metal floor deck.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Steel Deck:
 - a. ASC Profiles, Inc.
 - b. Verco Manufacturing Co.

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2.02 ROOF DECK

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 38 (250) zinc coating.
 2. Deck Profile: As indicated.
 3. Profile Depth: As indicated.
 4. Design Uncoated-Steel Thickness: As indicated.
 5. Span Condition: Double span or more.
 6. Side Laps: Interlocking seam.
 7. Do not shop prime.

2.03 COMPOSITE FLOOR AND ROOF DECK

- A. Composite Steel Floor and Roof Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 30, with the minimum section properties indicated, and with the following:
1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 38 (250), G60 (Z180) zinc coating.
 2. Profile Depth: As indicated.
 3. Design Uncoated-Steel Thickness: As indicated.
 4. Span Condition: Double span or more.

2.04 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) 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 (230 MPa), of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 30 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 (1.90 mm)] thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.
- J. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and level recessed pans of 1-1/2-inch (38-mm) minimum depth. For drains, cut holes in the field.
- K. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.
- L. Galvanizing Repair Paint: ASTM A 780, SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.02 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.
- B. Install 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.

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3.03 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:
 - 1. Weld Diameter: 3/4 inch (19 mm), nominal. (1/2 inch effective)
 - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space 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 indicated, and as follows:
 - 1. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
 - 1. End Joints: Lapped 2 inches (51 mm) minimum or butted at Contractor's option.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and [weld] [mechanically fasten] flanges to top of deck. Space welds not more than 12 inches (305 mm) apart with at least one weld at each corner.
 - 1. Install reinforcing channels or zeos in ribs to span between supports and weld.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.04 COMPOSITE ROOF AND FLOOR-DECK INSTALLATION

- A. Fasten deck panels to steel supporting members by installation of shear connectors where indicated and arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: 3/4 inch (19 mm), nominal. (1/2" effective)
 - 2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches (305 mm) apart, but not more than 18 inches (457 mm) apart.
 - 3. Weld Spacing: Space and locate welds as indicated.
 - 4. Weld Washers: Install weld washers at each weld location.
- B. Installation of Shear Studs: The studs shall be automatically end welded in accordance with the manufacturer's recommendations in such a manner as to provide complete fusion between the end of the stud and the plate. There should be no porosity or evidence of lack of fusion between the welded end of the stud and the plate. The stud shall decrease in length during welding approximately c" for e" and under, and 3/16" for over e" diameter. Welding shall be done only

by qualified welders approved by the welding inspector.

1. The studs shall be installed only by certified operators approved by the manufacturer and who are thoroughly familiar with the installation equipment. A copy of the operating instruction for the equipment shall be at the job site at all times.
 2. Installation and qualification of weld base shall meet the requirements of AWS D1.1 except as specified herein. Refer to Section 01410 for inspection requirements.
 3. Studs bent more than 15 degrees from the vertical by inspection and testing procedures shall be bent back to an acceptable angle and show no signs of failure if they are to be considered as part of the required studs. Otherwise they shall be replaced by additional studs.
 4. Studs that show no signs of failure will be accepted as shear connectors provided they meet the dimensional limitations indicated, provided no portion is less than one inch from a proposed concrete surface and provided bends or out of plumbness does not exceed 15 degrees.
 5. The studs shall have complete fusion to the steel beams underlying the decking. Where repairs are made by fillet welding, such welding shall be between stud and beam with removal or portions of the decking as required.
 6. Where the decking is thick due to heavy gage sheets or double sheets at cellular panels, holes in one or more sheets shall be made before stud welding where required to ensure fusion of studs to beams. When such holes are not made, fusion shall be verified.
 7. Ferrules shall be removed after completion
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals indicated as follows:
1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
 2. Mechanically clinch or button punch.
 3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches (38 mm), 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 according to SDI recommendations, unless otherwise indicated.

- E. Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.
- F. Cellular Deck: Install cellular deck system with deck assembled from all-cellular units.

3.05 FIELD QUALITY CONTROL

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

3.06 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

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SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Steel framing and supports for overhead doors and stage curtains.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Metal ladders.
5. Loose bearing and leveling plates for applications where they are not specified in other Sections.
6. Pipe rack in Cafetorium.

- B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

- C. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 05 12 00 "Structural Steel Framing."

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 metal fabrications that are anchored to or that receive other work. 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
 - 2. Metal nosings and treads.
 - 3. Paint products.
 - 4. Grout.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Steel framing and supports for overhead doors and stage curtains.
 - 2. Steel framing and supports for mechanical and electrical equipment.
 - 3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 4. Metal ladders.
 - 5. Pipe rack in scene shop.
- C. Samples for Verification: For each type and finish of extruded nosing.
- D. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Research/Evaluation Reports: For post-installed anchors.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Abrasive nosings shall comply with California Title 24.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- E. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- F. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
- G. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- H. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- I. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- J. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- K. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- L. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

METAL FABRICATIONS

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2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: 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 E 488/E 488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot dip galvanized per ASTM F 2329.
- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide product compatible with system as required per Sections 09 9113 "Exterior Painting," 09 9123 "Interior Painting," or 09 9601 "High-Performance Coatings" as appropriate for location and painting system indicated.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

METAL FABRICATIONS

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- D. 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.
- E. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

METAL FABRICATIONS

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2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- C. Galvanize miscellaneous framing and supports where indicated.

2.7 METAL LADDERS

- A. General:
 - 1. Comply with ANSI A14.3, except for elevator pit ladders.
 - 2. For elevator pit ladders, comply with ASME A17.1/CSA B44.
- B. Steel Ladders:
 - 1. Space siderails 18 inches apart unless otherwise indicated.
 - 2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
 - 3. Rungs: 3/4-inch-diameter steel bars.
 - 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 - 5. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Harsco Industrial IKG, a division of Harsco Corporation.
 - 2) ROSS TECHNOLOGY CORP.
 - 3) SlipNOT Metal Safety Flooring; W.S. Molnar Company.
 - 6. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
 - 7. Galvanize exterior ladders, including brackets.

2.8 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

- C. Galvanize exterior miscellaneous steel trim.

2.9 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.

2.10 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.11 PIPE RACK IN CAFETORIUM

- A. Fabricate pipe rack from 1-1/2 inch NPS Schedule 40 steel pipe. Provide configuration as detailed on drawings.

2.12 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.13 STEEL AND IRON FINISHES

- A. Galvanizing: Hot dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with primers specified in Section 099113 "Exterior Painting" and primers specified in Section 099123 "Interior Painting" unless zinc-rich primer is indicated.
- D. Preparation for Shop Priming: Clean surfaces to be painted per primer manufacturer's written instructions. Remove loose rust and mill scale and other spatter, slag, flux deposits, and any other potential bond-breaking materials.

METAL FABRICATIONS

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- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.14 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.
- C. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70percentPVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

METAL FABRICATIONS

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1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for overhead doors and stage curtains securely to, and rigidly brace from, building structure.

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 50 00

SECTION 05 70 00 - DECORATIVE METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal designs and laminates for interior spaces.
- B. Related Requirements:
 - 1. Section 06 41 16 Plastic-Laminate-Faced Architectural Cabinets
 - 2. Section 06 40 23 Interior Architectural Woodwork

1.3 COORDINATION

- A. Coordinate installation of anchorages for decorative metal items. 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including finishing materials.
- B. Shop Drawings: Show fabrication and installation details for decorative metal.
 - 1. Include plans, elevations, component details, and attachment details.
 - 2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
- C. Samples for Verification: For each type of exposed finish.

1.5 QUALITY ASSURANCE

- A. Installer: Minimum 2 years installing similar products.
- B. Mock-Ups: Build mock-ups to demonstrate esthetic effects and workmanship. Accepted mock-ups may remain in place.

- C. Fire Performance for Metal Materials: ASTM E84 Class A, flame spread index of 0, smoke developed index of 0.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in unopened, undamaged containers with identification labels intact.
- B. Storage and Handling: Comply with manufacturer's recommendations for storage and handling. Store flat and not on edge. Protect from weather damage.

1.7 PROJECT CONDITIONS

- A. Maintain a constant temperature range of 65°F to 85°F (18°C to 24°C), with stable relative humidity, for at least 48 hours prior to, throughout the installation period and maintained consistently thereafter.
- B. Installation locations must be enclosed, weatherproofed and climate controlled prior to commencing installation.
- C. Do not install if relative humidity is greater than 80%.

1.8 FIELD CONDITIONS

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

1.9 WARRANTY

- A. Provide manufacturer's warranty against defects in material and workmanship.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Use materials with smooth, flat surfaces unless otherwise indicated. Use materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.2 METAL DESIGNS AND LAMINATES

- A. Basis of Design: Chemetal, 39 O'Neill Street, Easthampton, MA 01027, tel. 800 807-7341, email sales@chemetal.com.
 - 1. Or Approved Equal.
- B. Description:
 - 1. Chemetal 300 Series – Metal Images:

- a. Color: 353 ALU Medium 09
 - b. Size: 4" high
- C. Installation: Install the work of this section in strict accordance with manufactures written Technical Information and workability guidelines
- D. Accessory Materials:
 - 1. Edgebanding as acceptable to manufacturer.
 - 2. Adhesives as acceptable to manufacturer.
- E. Substrates and Balancing Sheets:
 - 1. Chemetal must be laminated to MDF, HDF, better quality particleboard or very good quality plywood (Baltic Birch, for example).
 - 2. Do not apply directly to gypsum board (sheet rock), concrete or poor quality particle board.
 - 3. Balancing sheets of similar thickness and material are recommended for balanced construction to prevent warping.
- F. Fabrication: Comply with manufacturer's recommendations for fabrication including the following:
 - 1. Condition materials to ambient conditions of the surrounding before use. Provide for circulation of air around the components.
 - 2. Conditioning temperature shall be approximately 75 degrees F (24 degrees C), at 45 to 55 percent relative humidity.
 - 3. Use saws, routers and belt sanders in accordance with manufacturer's recommendations.
 - 4. Remove protective mask as soon as application is complete.

2.3 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Aluminum Items: Type 304 stainless-steel fasteners.
 - 2. Dissimilar Metals: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.
- C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless otherwise indicated.
- D. Post-Installed Anchors: Fastener systems with 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, Class Fe/Zn 5 unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

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

3.2 SURFACE PREPARATION

- A. Prior to installation, clean surface to remove dirt, debris and loose particles. Perform additional preparation procedures as required per the manufacturer's instructions.
- B. Protection: Take all necessary precautions to prevent damage to materials during installation.

3.3 INSTALLATION, GENERAL

- A. Install the work of this section in strict accordance with manufactures written Technical Information and workability guidelines
- B. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.
- C. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.
- D. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.
- E. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- F. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
 - 1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.

3.4 CLEANING AND PROTECTION

- A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

- B. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.
- C. 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 05 70 00

SECTION 06 10 00 - ROUGH CARPENTRY

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. Framing with dimension lumber.
 - 2. Wall, Siding and roof sheathing.
 - 3. Wood furring, blocking and nailers.
 - 4. Preservative and fire-retardant treatment of wood.

1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. OSB: Oriented strand board.
- E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

1.4 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 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, 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 1. Wood-preservative-treated wood.
 2. Fire-retardant-treated wood.
 3. Engineered wood products.
 4. Shear panels.
 5. Power-driven fasteners.
 6. Post-installed anchors.
 7. Metal framing anchors.

1.6 QUALITY ASSURANCE

- A. Lumber Grading Agency: Certified by ALSC.
- B. Plywood Grading Agency: Certified by APA.
- C. Accredited certification bodies shall be one of the following:
 1. Scientific Certification Systems, www.scscertified.com.

1.7 REGULATORY REQUIREMENTS

- A. Conform to CBC, California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, Chapter 23.
- B. Allowable stress design values shall follow the CBC, California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, Section 2306, ANSI/AWC NDS-2018 - National Design Specifications for Wood Construction, and ANSI/AWS SDPWS-2015 - Special Design Provisions for Wind and Seismic.

1.8 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 LUMBER MATERIALS

- A. Lumber Grading Rules: WCLIB and WWP. Lumber shall bear WCLIB grade stamp.
- B. Structural Framing, Studs, Plate and Blocking: Douglas Fir Species, No. 1 grade.
- C. Non-structural Light Framing Studs, Plate and Blocking: Douglas Fir species, No. 2 grade.
- D. Plank and Decking: Douglas Fir species, Com Dex.

2.2 MOISTURE CONTENT

- A. 2x and 3x material, 19 percent moisture content, S-Dry. Structural and non-structural framing, beam, rafters, joists, studs, plates and blocking.
- B. 4x and 6x material, 19 percent moisture content at time of application of Architectural finishes. 22 percent maximum moisture content at time of delivery to project site. Materials to be air dried as required to achieve
- C. 22 percent moisture content prior to delivery to site. Structural and non-structural framing, beam, rafters, joists, studs, plates and blocking.
- D. Lumber materials with a moisture content above 19 percent and less than 22 percent at the time of installation shall be tested for moisture content prior to covering with Architectural finishes. Moisture tests shall be performed under the provisions of Section 01 45 29.
- E. No lumber shall be covered with an Architectural finish until the moisture content of the lumber is 19 percent or below.

2.3 PLYWOOD MATERIALS

- A. Roof Sheathing: APA Structural I, Grade C-D, Exposure 1 minimum 5-ply construction, meeting product Standard PS-1-09.
- B. Wall Sheathing: APA Structural I, Grade C-D, Exposure 1 minimum 5-ply construction, meeting product standard PS-1-09.
- C. T1-11 Wall Sheathing: APA 303 Siding.
- D. Underlayment: APA Underlayment, Exposure 1, 3/8-inch-thick, sanded; minimum 3-ply construction.
- E. Telephone and Electrical Panel Boards: APA Grade C-D with exterior glue, minimum 5 ply, 3/4-inch-thick, meeting PS-1-09.

2.4 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment: Where lumber or plywood is indicated as treated or is specified herein to be treated, comply with applicable requirements of AWP Standards for Lumber and Plywood.
- B. Pressure treat all lumber in contact with ground. After treatment kiln-dry lumber to a maximum moisture content of 19 percent.
- C. Pressure treat above ground items as indicated. After treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Treat indicated items and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping and similar members in connection with roofing, flashing, vapor barriers and waterproofing.
 - 2. Horizontal wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry or concrete.
 - 3. Horizontal wood framing members less than 18 inches above grade.
 - 4. Wood floor plates installed over concrete slabs directly in contact with earth.
 - 5. Ends of wood girders entering masonry or concrete walls.
 - 6. Framing members used in exterior door, window, or louver openings.
- D. Complete fabrication of treated items prior to treatment, where possible. If cut or drilled after treatment, coat cut or drilled surfaces with heavy brush coat of same chemical used for treatment and to comply with AWP M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.5 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply 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 Lumber and 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. Treatment shall not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 - 4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.

- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency.
- E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat items indicated on Drawings, and the following:
 - 1. Concealed blocking.
 - 2. Framing for non-load-bearing partitions.
 - 3. Framing for non-load-bearing exterior walls.
 - 4. Roof construction.
 - 5. Plywood backing panels.

2.6 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Cants.
 - 5. Furring.
 - 6. Grounds.
- B. Dimension Lumber Items: Douglas Fir, No. 2 grade lumber.
- C. For blocking not used for attachment of other construction, No. 2 grade lumber of any species may be used if it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. 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.
- E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.7 ACCESSORIES

- A. Fasteners: Hot-dipped galvanized steel for exterior, high humidity, and treated wood locations; plain finish elsewhere; size and type to suit condition.
- B. Connectors: As indicated.

- C. Anchors: Thru bolt or anchor bolt to concrete or masonry unless otherwise noted. Bolt for anchorage to steel unless otherwise noted.
- D. Building Paper: No. 15 asphalt felt. Plain untreated cellulosic building paper.
- E. Nails, Brads, and Staples: ASTM F 1667.
- F. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- G. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.8 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. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.
- C. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
- D. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with ANSI/AWC NDS-2018, "National Design Specification (NDS) for Wood Construction – with 2018 NDS Supplement," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

ROUGH CARPENTRY

06 10 00-6

- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Install shear wall panels to comply with manufacturer's written instructions.
- F. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- G. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- H. Do not splice structural members between supports unless otherwise indicated.
- I. 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.
- J. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
 - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
 - 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 10 feet o.c.
- K. Sort and select lumber so that natural characteristics do 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.
- L. Comply with AWWA U1 and 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.
- M. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- N. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in the 2019 California Building Code.

2. ICC-ES evaluation report for fastener.
- O. Use steel common 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. Drive nails snug but do not countersink nail heads unless otherwise indicated.
- P. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
 1. Comply with approved fastener patterns where applicable. Before fastening, mark fastener locations, using a template made of sheet metal, plastic, or cardboard.
 2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
 3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 FRAMING

- A. Erect wood framing members level and plumb.
- B. Place horizontal members laid flat, crown side-up.
- C. Construct framing members full length without splices.
- D. Double members at openings over 1 sq. ft. Space short stud over and under opening to stud spacing.
- E. Construct double joist headers at floor and ceiling openings. Frame rigidly into joists.
- F. Construct double joists under wall studding.

3.3 WOOD FURRING, BLOCKING, AND GROUNDS

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Item locations include but are not limited to toilet accessories, toilet partitions, door frames, window frames, hardware, access doors and ladders, cabinetry, miscellaneous equipment locations and mechanical, plumbing and electrical item locations and all other locations of wall mounted items.
- C. Install plywood backboards for telephone, data and other electrical equipment.
- D. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
- E. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated.

- F. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
- G. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finished work.
- H. Firestop all concealed spaces of wood stud walls, ceilings and floor levels at 10-foot intervals both vertically and horizontally.
- I. Firestop all concealed vertical and horizontal spaces as occur at soffits, vents, stair stringers, pipes and similar openings in compliance with CBC, (CCR) Title 24, Part 2, Section 717.
- J. Fire stopping shall consist of closely fitted wood blocks of 2-inch nominal thickness lumber of same width as framing members.
- K. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

3.4 SHEATHING

- A. Secure roof sheathing perpendicular to framing members with ends staggered. Secure sheet edges over firm bearing. Provide solid edge blocking between sheets. Space panels 1/8 inch apart at ends and edges.
- B. Secure wall sheathing perpendicular to wall studs, with ends staggered, over firm bearing.
- C. Install telephone and electrical panel back boards where required. Size of backboards to be 12 inches beyond size of electrical panel boards.

3.5 PROTECTION

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

3.6 RECYCLING CONSTRUCTION WASTE

- A. Recycle lumber waste under the provisions of Division 01 specifications.

3.7 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 01 specifications.

- B. Lumber materials will be inspected for compliance with material grading rules, limitations for moisture content and pest infestation prior to any materials being concealed from view or being covered with an architectural finish.

3.8 TOLERANCES

- A. Framing Members: 1/4 inch maximum from true position.
- B. Surface Flatness of Floor: 1/4 inch in 10 feet maximum.

END OF SECTION 06 10 00

SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Interior standing and running trim.
2. Flush wood paneling.
3. Interior woodwork (collaboration areas tiered seating, media lounge bench niche and tiered seating, wall paneling, stairs and other items as indicated on Drawings)
4. Wood furring, blocking, shims, and hanging strips for installing interior architectural woodwork items that are not concealed within other construction.
5. 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 12 36 61.16 "Solid Surfacing Countertops" for solid surface facing material applied to interior architectural woodwork.

1.3 REFERENCES

- A. The North American Architectural Woodwork Standards (NAAWS), latest edition. Jointly published by Woodwork Institute and the Architectural Woodwork Manufacturers Association of Canada.

1.4 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.

1.5 PREINSTALLATION MEETINGS

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

1.6 ACTION SUBMITTALS

A. Product Data: For the following:

1. Anchors.
2. Adhesives.
3. Shop finishing materials.
4. Wood-Preservative Treatment:
 - a. Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
 - b. Indicate type of preservative used and net amount of preservative retained.
 - c. Include chemical-treatment manufacturer's written instructions for finishing treated material and manufacturer's written warranty.
5. Fire-Retardant Treatment: Include data and warranty information from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
6. Waterborne Treatments: For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

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 WI 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.

1.7 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.

- C. Evaluation Reports: For [preservative-treated] [and] [fire-retardant-treated] wood materials, from ICC-ES.
- D. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

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

1.9 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 WI's Quality Certification Program.
 - 2. Installer Qualifications: Licensed participant in WI's Quality Certification Program.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the North American Architectural Woodwork Standards for delivery, storage and handling.
- 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. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

1.11 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.

1.12 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 "North American Architectural Woodwork Standards (NAAWS)" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
 - 1. Provide labels and certificates from WI certification program indicating that woodwork and installation complies with requirements of grades specified.
 - 2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

2.2 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Grade: Premium.
- B. Hardwood Lumber:
 - 1. Wood Species and Cut: As indicated in Finish Schedule on Drawings.
 - 2. Wood Moisture Content: 5 to 10 percent.
 - 3. For trim items other than base wider than available lumber, use veneered construction. Do not glue for width.
 - 4. For base wider than available lumber, glue for width. Do not use veneered construction.
 - 5. For rails thicker than available lumber, use veneered construction. Do not glue for thickness.

2.3 FLUSH WOOD PANELING (WOOD-VENEER WALL SURFACING)

- A. Grade: Premium.
- B. Wood Species and Cut: As indicated in Interior Finish Schedule.
- C. Veneer Matching Method:

1. Adjacent Veneer Leaves: Book match, unless noted otherwise.
 2. Within Panel Face: Balance match, unless noted otherwise.
 3. Adjacent Veneer Leaves and within Panel Face: Slip, center-balance, or book match.
- D. Panel-Matching Method:
1. No matching is required between adjacent panels. Select and arrange panels for similarity of grain pattern and color between adjacent panels.
- E. Panel Core Construction: Fire-retardant particleboard or fire-retardant MDF.
1. Thickness: As indicated.
- F. Exposed Panel Edges: Inset solid-wood or wood-veneer matching faces.
- G. Fire-Retardant-Treated Paneling: Panels shall consist of wood-veneer and fire-retardant particleboard or fire-retardant, medium-density fiberboard (MDF). Panels shall have a flame-spread index of 25 or less and a smoke-developed index of 450 or less per ASTM E 84, and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
- H. Assemble panels by gluing and concealed fastening.

2.4 HARDWOOD SHEET MATERIALS

- A. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of the North American Architectural Woodwork Standards for each type of interior architectural woodwork and quality grade specified unless otherwise indicated.
1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
 2. Particleboard: ANSI A208.1, Grade M-2.
 3. Softwood Plywood: DOC PS 1, medium-density overlay.
 4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.5 PRESERVATIVE-TREATED-WOOD MATERIALS

- A. Preservative-Treated-Wood Materials: Provide with water-repellent preservative treatment complying with AWWPA N1 (dip, spray, flood, or vacuum-pressure treatment).
1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC), combined with a compatible EPA-registered insecticide.
 2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
- B. Extent of Preservative-Treated Wood Materials: Treat interior architectural woodwork in contact with concrete or masonry.
1. Items fabricated from the following wood species need not be treated:

- a. All-heart redwood.
- b. All-heart western red cedar.
- c. White oak.
- d. African mahogany.
- e. Honduras mahogany.
- f. Ipe.
- g. Dark red meranti.
- h. Teak.

2.6 FIRE-RETARDANT-TREATED WOOD MATERIALS

- A. Fire-Retardant-Treated Wood Materials: Where fire-retardant-treated materials are indicated, use materials complying with requirements that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products according to test method indicated by a qualified testing agency.
 - 1. Use treated materials that comply with requirements of the North American Architectural Woodwork Standards. Do not use materials that are warped, discolored, or otherwise defective.
 - 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
 - 3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.
- B. Fire-Retardant-Treated Lumber and Plywood: Products with a flame-spread index of 25 or less when tested according to ASTM E84, 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. Kiln-dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
 - 2. For items indicated to receive a stained, transparent, or natural finish, use organic resin chemical formulation.
 - 3. Mill lumber after treatment within limits set for wood removal that do not affect listed fire-test-response characteristics, using a woodworking shop certified by testing and inspecting agency.
 - 4. Mill lumber before treatment, and implement procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
- C. Fire-Retardant Particleboard: Made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture, to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less according to ASTM E84.
 - 1. For panels 3/4 inch thick and less, comply with ANSI A208.1 for Grade M-2, except for the following minimum properties: modulus of rupture, 1600 psi; modulus of elasticity, 300,000 psi; internal bond, 80 psi; and screw-holding capacity on face and edge, 250 and 225 lbf, respectively.

2. For panels 13/16 to 1-1/4 inches thick, comply with ANSI A208.1 for Grade M-1, except for the following minimum properties: modulus of rupture, 1300 psi; modulus of elasticity, 250,000 psi; linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf, respectively.
- D. Fire-Retardant Fiberboard: Medium-density fiberboard (MDF) panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture, to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less according to ASTM E84.

2.7 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, AWPA 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.
 2. Fire-Retardant Treatment: Complying with requirements; provide where indicated.
- 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. Adhesives: Do not use adhesives that contain urea formaldehyde.
- E. Adhesives: Use adhesives that meet 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. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.
 1. Verify adhesives have a VOC content of 70 g/L or less.
 2. Verify adhesive complies 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."

2.8 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. 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.
- C. 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.

2.9 SHOP FINISHING

- A. Finish interior architectural woodwork with transparent finish at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Preparation for Finishing: Comply with North American 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.
 - 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 - 11, Polyurethane, Catalyzed.
 - 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 approved sample for color.
 - 5. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
 - 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. General: Install all work in conformance with the North American Architectural Woodwork Standards, latest edition.
- B. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.
- C. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.
- D. 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.
- E. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- F. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes according to AWWPA M4.
- G. Fire-Retardant-Treated Wood: Install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- H. 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. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with interior architectural woodwork.
 - 3. For shop-finished items, use filler matching finish of items being installed.
- I. 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 36 inches long, except where shorter single-length pieces are necessary.
 - 3. Scarf running joints and stagger in adjacent and related members.

INTERIOR ARCHITECTURAL WOODWORK

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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 WI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the North American 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 North American 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 semiexposed surfaces.

END OF SECTION 06 40 23

SECTION 06 41 16 - PLASTIC-LAMINATE-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. Plastic-laminate-faced architectural cabinets.
 - 2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

- B. Related Requirements:

- 1. Section 06 10 00 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
 - 2. Section 12 36 23.13 "Plastic-Laminate Clad Countertops"
 - 3. Section 12 36 61.16 "Solid Surfacing Countertops"
 - 4. Section 12 35 53.19 "Wood Laboratory Casework"

1.3 REFERENCES

- A. WI - Woodwork Institute of California: Architectural Woodwork Standards.
- B. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- C. ASTM A653 - Steel Sheet, Zinc Coated, (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- D. ASTM A924 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- E. ASTM C615 – Standard Specification for Granite Dimension Stone.
- F. ASTM E84 – Test Method for Surface Burning Characteristics of Building Materials.
- G. CBC – California Building Code, (CCR) California Code of Regulations, Title 24, Part 2.

1.4 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: 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 plastic-laminate cabinets.
 - 4. Provide WI Certified Compliance Label on first page of shop drawings. Include WI inspector's signature.
- C. Samples: For each exposed product and for each color and texture specified, in manufacturer's or fabricator's standard size.

1.5 INFORMATIONAL SUBMITTALS

- A. Provide WI certificates of compliance and inspection reports.

1.6 REGULATORY REQUIREMENTS

- A. Operable parts for all accessible casework shall comply with CBC Section 11B-309.
- B. Conform to CBC requirements for flame spread classification in accordance with CBC Section 803 and Table 803.5.
- C. Conform to Flame Spread Classifications for Interior Millwork for flame spread ratings as tested according to ASTM E84.

1.7 QUALITY ASSURANCE - MONITORED COMPLIANCE PROGRAM

- A. Manufacture casework items in accordance with quality standards of the Architectural Woodwork Standards of the Woodwork Institute.
- B. All millwork and the installation of millwork shall be monitored for compliance under the scope of the WI Monitored Compliance Program (MCP).
- C. Fees charged by the Woodwork Institute for their monitored compliance service are the responsibility of the casework manufacturer.
- D. Provide WI Inspection Service at the millwork fabricator. Provide to Architect a written report showing the results of the inspection.
- E. Provide WI Certified Compliance Labels on all items of casework and countertops.

- F. Provide WI Inspection Service at the job site. Provide to Architect a written report showing the results of the inspection.
- G. Self-Certification by the millwork fabricator or inspection by other than an authorized representative of The Woodwork Institute is not acceptable.
- H. Upon completion of the installation, provide a WI Monitored Compliance Certificate.

1.8 MOCKUPS

- A. Prepare mockup under provisions of Division 01 specifications.
- B. Provide full size base cabinet and upper cabinet of each type indicated, in specified finish with hardware installed.
- C. Units will be examined to ascertain quality and conformity to WI standards.
- D. Units will establish a minimum standard of quality for this work.
- E. Approved units may be used as part of the Work.

1.9 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.

1.10 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Area of casework installation shall be fully enclosed, well ventilated, and protected from direct sunlight, excessive heat, rain or moisture.
 - 2. Relative humidity of the area of casework installation shall be maintained between 45 percent and 65 percent with a temperature range of between 60 degrees F to 90 degrees F.
 - 3. Casework shall be acclimated to the area of installation for a minimum of 72 hours prior to installation.
- 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.

1.11 COORDINATION

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

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Active member of the Woodwork Institute licensed by WI to provide WI Certified Compliance Certificates and Labels for the products and materials specified in this section www.woodworkinstitute.com.

2.2 CABINET DESIGN

- A. Individual cabinets are indicated on the drawings by the WI Cabinet Design Series (CDS) numbering system, Appendix A.

2.3 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Fabricate in accordance with Section 10 of the Manual of Millwork:

- | | |
|-----------------------|--|
| 1. WI Grade: | Custom. |
| 2. Core Material: | MDF or Particle board
www.columbiaforestproducts.com . |
| 3. Type: | Type A. |
| 4. Construction: | Style A-Frameless. |
| 5. Joinery: | Doweled Joints. |
| 6. Cabinet Backs: | Blind Dadoed. |
| 7. Cabinet Door Type: | Interface Style 1, Type A, flush overlay. |
| 8. Shelves: | 1-M-2 particle board, 1 inch thick, MOE of 950, capable of supporting 50 lb./sq. ft load with deflection of L/144. |
| 9. Shelf Edge Bands: | 1mm PVC in color to match shelf. All 4 edges of adjustable shelves to receive banding. |

PLASTIC-LAMINATE FACED ARCHITECTURAL CABINETS

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10. Door and Drawer Edge Bands: 3mm PVC radiused 1/8 inch at edge. Solid color as selected by Architect.
11. Exposed Surfaces (Including shelves and interior of open front cabinets): 0.028-inch-high pressure plastic laminate, color and pattern as selected by Architect. A maximum of 5 colors and patterns to be selected. A minimum of 3 color combinations per room may be selected.
12. Semi-Exposed Surfaces (Behind doors and inside drawers): Low pressure decorative polyester or melamine laminate ALA-85.
13. Security and Dust Panels: Particle board, 3/4-inch-thick at all lockable drawers.

2.4 HARDWARE

- A. Finish: Satin Aluminum.
- B. Silencer: Provide as required of cabinet doors.
- C. Shelf Supports: Metal or molded polycarbonate clips set in drilled holes spaced 32 mm on center. Clips to have vertical locating pin for retention of shelf.
- D. Drawer and Door Pulls: Extruded aluminum, Satin Stainless Steel, refer to Finish schedule for additional detail.
- E. Cabinet Locks: Provide cylinder deadbolt; Olympus 4 pin keyway 100/200 series at small doors/drawers. Use Olympus 700/800 series at large cabinet doors such as trophy cases, etc. Use 4 separate keys in alternating rooms, all casework in a room keyed alike.
- F. Drawer Slides: Model No. 1429; full extension; side mounting; 100 pounds rated; wide paper drawers use 200 lb. rated; manufactured by Knape and Vogt Manufacturing Co.; (616) 459-3311, or approved equivalent.
- G. File Drawer Slide: Model No. 3640; full extension; side mounting; 200 pounds rated; manufactured by Accuride; (310) 903-0200, or approved equivalent.
- H. Hinges: Rocker B-Series heavy duty wrap-around tight pin butts of steel 2-1/2" minimum width with companion magnetic door catch; or approved equivalent.
- I. Sliding Door Track Assemblies: Grant 2023N sheaves and Grant 2011 track.
- J. Grommets: Provide 2-1/2" diameter plastic grommet at countertops; color to match countertop.
- K. Hanger Rods: 1-1/16-inch diameter tubing, stainless steel.
- L. Seismic Shelf Lip: 1/4-inch-thick x 3-inch-high acrylic plastic or PVC edging of color selected by Architect. Ease all edges of plastic.
- M. Remainder of hardware required shall meet requirements of ANSI/BHMA Grade P.
- N. Substitutions: Under the provisions of Division 01.

2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood 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.
- D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.6 FABRICATION

- A. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- C. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings. Verify locations of cutouts from on-site dimensions. Seal contact surfaces of cut edges.
- D. Provide all supports and required inserts for laboratory type sink units.
- E. Install plastic grommets in the field in plastic laminate casework and Owner furnished furniture as directed by the Owner's Representative and/or Architect.
- F. Install seismic shelf lips on all exposed edges of open shelving with flathead countersunk wood screws spaced 6 inches on center. Finish exposed screw heads to match color of shelf lip.
- G. Install one adjustable shelf for each 1'-0" of height for all wall mounted cabinets. Shelves to be 1-M-2 particle board, 1 inch thick, MOE of 950, capable of supporting 50 lb./sq. ft load with deflection of L/144. Shelves not to be over 3'-0" long without supports. Shelf edge bands 1mm PVC in color to match shelf. All 4 edges of adjustable shelves to receive banding.
- H. Provide stretcher at top face of all door and drawer fronts.
- I. Provide locks on all doors and drawers.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify adequacy of backing and support framing.

3.2 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.

3.3 INSTALLATION

- A. Set and secure casework in place rigid, plumb, and level.
- B. Install casework in accordance with Section 10 and Appendix B of the Architectural Woodwork Standards.

3.4 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. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly and correctly.
- C. Clean casework, counters, shelves, hardware, fittings and fixtures.

END OF SECTION 06 41 16

SECTION 070150.19 - PREPARATION FOR REROOFING

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. Full tear-off of entire roof system.
 - 2. Removal of flashings and counterflashings.

1.3 DEFINITIONS

- A. EPS: Molded (expanded) polystyrene.
- B. Full Roof Tear-off: Removal of existing roofing system down to existing roof deck.
- C. OSB: Oriented strand board.
- D. Partial Roof Tear-off: Removal of selected components and accessories from existing roofing system.
- E. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

- A. Preliminary Roofing Conference: Before starting removal Work, conduct conference at Project site.
 - 1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing 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 tear-off, including, but not limited to, the following:
 - a. Reroofing preparation, including roofing system manufacturer's written instructions.
 - b. Temporary protection requirements for existing roofing system components that are to remain.
 - c. Existing roof drains and roof drainage during each stage of reroofing, and roof-drain plugging and plug removal.

- d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to avoid delays.
- e. Existing roof deck conditions requiring Architect notification.
- f. Existing roof deck removal procedures and Owner notifications.
- g. Condition and acceptance of existing roof deck and base flashing substrate for reuse.
- h. Structural loading limitations of roof deck during reroofing.
- i. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that affect reroofing.
- j. HVAC shutdown and sealing of air intakes.
- k. Shutdown of fire-suppression, -protection, and -alarm and -detection systems.
- l. Asbestos removal and discovery of asbestos-containing materials.
- m. Governing regulations and requirements for insurance and certificates if applicable.
- n. Existing conditions that may require Architect notification before proceeding.

1.5 ACTION SUBMITTALS

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

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
 - 1. Include certificate that Installer is approved by warrantor of existing roofing system.
 - 2. Include certificate that Installer is licensed to perform asbestos abatement.
- B. Field Test Reports:
 - 1. Fastener pull-out test report.
- C. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces, that might be misconstrued as having been damaged by reroofing operations.
 - 1. Submit before Work begins.
- D. Landfill Records: Indicate receipt and acceptance of demolished roofing materials and hazardous wastes, such as asbestos-containing materials, by a landfill facility licensed to accept them.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with governing EPA notification regulations before beginning roofing removal.
 - 2. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.8 FIELD CONDITIONS

- A. Owner will not occupy portions of building immediately below reroofing area.
- B. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
- C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
- D. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.
- E. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.
 - 1. Remove only as much roofing in one day as can be made watertight in the same day.
- F. Hazardous Materials: hazardous materials, such as asbestos-containing materials, may be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. Existing roof will be left no less watertight than before removal.
 - 3. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.
 - a. Hazardous materials will be removed by Owner under a separate contract.

PART 2 - PRODUCTS

2.1 TEMPORARY PROTECTION MATERIALS

- A. EPS Insulation: ASTM C578.
- B. Plywood: DOC PS 1, Grade CD, Exposure 1.
- C. OSB: DOC PS 2, Exposure 1.

2.2 INFILL AND REPLACEMENT MATERIALS

- A. Use infill materials matching existing roofing system materials unless otherwise indicated.
- B. Plywood roof sheathing, wood blocking, curbs, and nailers are specified in Section 061000 "Rough Carpentry."
- C. Fasteners: Factory-coated steel fasteners with metal or plastic plates listed in FM Approvals' RoofNav, and acceptable to new roofing system manufacturer.

2.3 AUXILIARY REROOFING MATERIALS

- A. General: Use auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of existing and new roofing system.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
1. Protect existing roofing system that is not to be reroofed.
 2. Loosely lay 1-inch- minimum thick, EPS insulation over existing roofing in areas not to be reroofed.
 - a. Loosely lay 15/32-inch plywood or OSB panels over EPS. Extend EPS past edges of plywood or OSB panels a minimum of 1 inch.
 3. Limit traffic and material storage to areas of existing roofing that have been protected.
 4. Maintain temporary protection and leave in place until replacement roofing has been completed. Remove temporary protection on completion of reroofing.
 5. Comply with requirements of existing roof system manufacturer's warranty requirements.
- B. Seal or isolate windows that may be exposed to airborne substances created in removal of existing materials.
- C. Shut off rooftop utilities and service piping before beginning the Work.
- D. Test existing roof gutters to verify that they are not blocked or restricted.
1. Immediately notify Architect of any blockages or restrictions.
- E. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work.
1. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.
- F. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.
- G. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday.
1. Prevent debris from entering or blocking roof drains and conductors.
 - a. Use roof-drain plugs specifically designed for this purpose.
 - b. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
 2. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding.

- a. Do not permit water to enter into or under existing roofing system components that are to remain.

3.2 ROOF TEAR-OFF

- A. Notify Owner each day of extent of roof tear-off proposed for that day.
- B. Lower removed roofing materials to ground and onto lower roof levels, using dust-tight chutes or other acceptable means of removing materials from roof areas.
- C. Remove loose aggregate from aggregate-surfaced, built-up bituminous roofing using a power broom.
- D. Remove pavers and accessories from roofing.
 1. Store and protect pavers and accessories for reuse in manner not to exceed structural loading limitations of roof deck.
 2. Discard cracked pavers.
- E. Full Roof Tear-off: Remove existing roofing and other roofing system components down to the existing roof deck, unless indicated otherwise on drawings. Existing roof gutters shall remain.
 1. Remove substrate board, vapor retarder roof insulation and cover board.
 2. Remove base flashings and counter flashings.
 3. Remove perimeter edge flashing and gravel stops.
 4. Remove expansion-joint covers.
 5. Remove flashings at pipes, curbs, mechanical equipment, and other penetrations.
 6. Remove roof drains indicated on Drawings to be removed.
 7. Remove wood blocking, curbs, and nailers.
 8. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry.
 - a. Remove unadhered bitumen, unadhered felts, and wet felts.
 9. Remove fasteners from deck.
 10. Provide temporary support of pipes and conduit supported by or over the roof assembly.

3.3 DECK PREPARATION

- A. Inspect deck after tear-off of roofing system.
- B. If broken or loose fasteners that secure deck panels to one another or to structure are observed, or if deck appears or feels inadequately attached, immediately notify Architect.
 1. Do not proceed with installation until directed by Architect.
- C. If deck surface is unsuitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect.
 1. Do not proceed with installation until directed by Architect.
- D. Provide additional deck securement as indicated on Drawings.

- E. Replace plywood roof sheathing at damaged areas and as indicated on Drawings.

3.4 BASE FLASHING REMOVAL

- A. Remove existing base flashings.
 - 1. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.
- B. Do not damage metal counterflashings that are to remain.
 - 1. Replace metal counterflashings damaged during removal with counterflashings specified in Section 076200 "Sheet Metal Flashing and Trim."

3.5 FASTENER PULL-OUT TESTING

- A. Retain independent testing and inspecting agency to conduct fastener pull-out tests according to SPRI FX-1, and submit test report to Architect and roofing manufacturer before installing new roofing system.
 - 1. Obtain roofing manufacturer's approval to proceed with specified fastening pattern.
 - a. Roofing manufacturer may furnish revised fastening pattern commensurate with pull-out test results.

3.6 DISPOSAL

- A. Collect demolished materials and place in containers.
 - 1. Promptly dispose of demolished materials.
 - 2. Do not allow demolished materials to accumulate on-site.
 - 3. Storage or sale of demolished items or materials on-site is not permitted.
- B. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION 070150.19

SECTION 07 01 50.61 – ROOF COATING FOR RESTORING AGED METAL ROOFING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. This specification provides a remedial roof coating for application over existing weathered metal roofing systems of all profiles. Application is restricted to circumstances in which the metal panel substrate is in sound condition but requires a rejuvenation of the overall finish to prolong the useful life of the metal roofing system. When properly applied in conjunction with seam restoration and fastener replacement, the GacoFlex S42 Series Elastomeric Silicone Roof Coating provides a weathertight seal that protects the substrate from degradation caused by ultra violet light (UV), water, and other normal weathering hazards. The metal panels must be free of deflection and should have a slope ratio of 2:12 or greater to promote positive drainage.
2. Suitable metal surfaces to receive a GacoFlex S42 Series Elastomeric Silicone Roof Coating include steel (aged at least one year or treated galvanized steel), anodized aluminum, and pre-finished metal (other than siliconized and fluorocarbon finishes). The GacoFlex S42 Series Elastomeric Silicone Roof Coating is intended to renew an existing finish or add improved reflectivity to bare metal.
3. Adhesion tests are strongly recommended prior to bidding. A Coating Applicator that is licensed by the product manufacturer should perform wet and dry adhesion tests as instructed in GacoFlex General Instructions GW-1-3 Adhesion Testing Procedures using the products listed in Section 2.2.

- B. RELATED SECTIONS

1. 07 62 00 – Sheet Metal Flashing and Trim
2. 07 72 00 – Roof Accessories

1.3 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's standard submittal package including specification, installation instructions and general information for each waterproofing material.
- B. Applicator Qualifications: Submit current Letter of Good Standing from the specified waterproofing manufacturer.

- C. Substrate Conditions: Applicator to present to owner a completed inspection report verifying substrate condition and any noted defects not specifically addressed in regard to the installation of the coating.
 - 1. Surface shall be free from loose dirt, stone, debris, moisture, and shall be in stable condition. Any work on the area to receive this application shall be completed prior to the installation of the coating.
 - 2. Applicator shall complete a substrate inspection prior to the start of the installation of the coating. The architect/owner and Applicator shall accept the substrate. Start of the work constitutes acceptance.

1.4 QUALIFICATIONS

- A. Primary waterproofing materials shall be the products of a single manufacturer. Secondary materials shall be recommended by the primary manufacturer. The manufacturer shall have a minimum of ten (10) years' experience in the manufacture of materials of this type.
- B. Applicators shall have a minimum of five (5) years' experience in the application of waterproofing materials of the type specified. The Applicator shall possess a current Letter of Good Standing from the specified waterproofing manufacturer.
- C. Pre-Installation Conference: Prior to the commencement of the installation, meet at the jobsite with a representative of the coating manufacturer, Applicator, general contractor, architect, and other parties affected by this section. Review the methods and procedures, substrate conditions, scheduling, and safety.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Owner/owner's representative shall reject damaged or non-conforming materials. Rejected materials must be removed immediately from the job site.
- B. Store the coating materials as recommended by the manufacturer and conforming to applicable safety regulatory agencies: town or city, state, and federal. Refer to all applicable data including, but not limited to: Safety Data Sheets, Product Data Sheets, product labels, and specific instructions for personal protection.
- C. Provide adequate ventilation, protection from hazardous fumes, and overspray potential to workers and associated trades in close proximity of the site application.

1.6 WARRANTY

- A. Manufacturer warrants that the material supplied will meet or exceed physical properties as published. The Applicator guarantees that workmanship will be free of defects in coating application. Since performance of previously applied coatings is beyond the control of Manufacturer and Applicator, requests for additional warranty coverage shall be subject to prior approval by Manufacturer.
- B. A FIFTEEN (15) YEAR MATERIAL AND LABOR WARRANTY MUST BE SUPPLIED BY THE PRODUCT MANUFACTURER.
- C. PROTECTION OF BUILDING AND OCCUPANTS:

1. All surfaces not to receive the coating specified shall be protected from overspray hazard, e.g., windows, doors, exterior surfaces and facades, parking lots, and vehicles. Protective coverings shall be secured against wind and shall be vented if used in conjunction with applications preventing collection and moisture.
 2. Applicator to post signs noting potential overspray hazard within 400 ft (122 m) of applications.
 3. All air intake ventilation equipment shall be turned off to prevent fumes from entering building.
 4. Surfaces damaged during application shall be restored at no expense to the owner.
 5. No smoking signs to be posted as mandated by local fire officials.
- D. SUBSTRATE: Proceed with work as specified only after substrate construction, preparation, and detail work has been completed.
- E. EQUIPMENT: All equipment used during operations shall be located so as not to adversely affect the daily operations or endanger occupants, structure, or materials on-site. All spray equipment must be grounded during operations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Gaco, www.gaco.com
1. Or approved equal

2.2 MATERIALS

- A. CLEANER: GacoFlex GacoWash Concentrated Cleaner
- B. SACRIFICIAL TAPE: Scotch Blue™ Original Painter's Tape or equivalent (as needed)
- C. PRIMER: GacoPrime LVOC Primer (as needed)
1. ALTERNATE: GacoFlex E5320 2-Part Epoxy Primer/Filler (as a rust inhibitor)
- D. FLASHING:
1. GacoFlex 66S Reinforcing Polyester Mesh
 2. GacoFlex SF4200 Seam Seal
 3. GacoPatch Silicone Roof Sealant
- E. COATING: GacoFlex S42 Series Elastomeric Silicone Roof Coating having the following physical properties:

GacoFlex S42 Series Elastomeric Silicone Roof Coating		
PROPERTY	VALUE	TEST METHOD
TENSILE STRENGTH	450 psi (3.1 MPa)	ASTM D412
ELONGATION AT BREAK (0 °F (-18 °C))	169 %	ASTM D412
SOLIDS	96.5 % by weight 95 % by volume	ASTM D1644 ASTM D2697
VOC	37 g / L (0.081 lb. / gal)	EPA Method 24
REFLECTANCE (INITIAL)	0.88	C1549

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Metal panels must be structurally sound and securely fastened. Severe oxidation may render some panels unsuitable to serve as a proper substrate for the coating and should be replaced as needed.
- B. Verify that substrate is ready to receive work; surface is clean, dry, and free of substances that could affect bond.
- C. Verify that all other work involved with this area, done under other sections, has been completed and accepted by the architect, general contractor, or owner prior to starting the waterproofing application.

3.2 PREPARATION

- A. NOTE: IT IS EXTREMELY IMPORTANT FOR THE ROOF TO BE CLEAN AND DRY.
- B. Inspect metal fasteners and retighten where possible. Where fasteners are stripped out, missing, corroded, or neoprene grommets are deteriorated, replace with oversize screws. Inspect horizontal and vertical seams, panel end laps, and tension bars/straps. Where necessary, remove fasteners to separate the panels, remove existing sealant, add new butyl caulk, and re-secure with new fasteners to create a water-tight compression seal.
- C. Remove heavy deposits of dirt, leaves and other debris from the roof using a stiff broom. Then apply GacoWash Concentrated Cleaner according to label instructions with sprayer of choice, using a 3 - 4 ft (0.9 - 1.2 m) arc pattern. A Hudson-type agricultural sprayer, conventional pressure sprayer or airless sprayer is recommended. Allow solution to stand for 10-15 minutes, adding a light mist of water to prevent drying. While it sets, lightly agitate any heavily soiled areas with a broom or brush. Do not allow dirt to settle in low areas. Use a commercial power washer >3,000 psi (21 MPa) to remove debris and continue rinsing until all suds are gone. Start at the highest point of the roof and work towards the lowest point. For low-sloped roofs, work away from and then back towards, roof drains. It is important to keep the surface wet until all of the GacoWash and other residue has been completely rinsed off and the surface is clean. After cleaning and rinsing the roof, ensure no dirt or debris is present.
- D. BIOLOGICAL CONTROL: Areas of algae, mildew or fungus on the roof or an existing coating should be treated with a solution of 1-part household bleach to 3-parts water, followed by a power wash rinse using clean water.
- E. DRYING: Allow surfaces to dry thoroughly. Examine the roof, paying particular attention to areas of physical damage or previous repairs to determine that residual water has in fact dried before applying GacoFlex S42 Series Roof Coating.

NOTE: Drying time depends on weather conditions such as temperature, humidity, and air movement. The above drying times assume good weather (70 °F / 21 °C daytime temperature) and no rain. Conditions of lower temperature and rain will require a longer period for drying.

- F. Structurally sound metal panels with moderate to extensive oxidation should be cleaned and/or lightly abraded to remove loose surface rust and treated with a rust-inhibiting primer to help prevent corrosion from spreading.

3.3 INSTALLATION

- A. TECHNICAL ADVICE: The installation of this coating shall be accomplished with the advice of, the manufacturer's technical representative. Contact Technical Services for assistance.
- B. PRIMER:
 - 1. COVERAGE RATE: If adhesion testing indicated the need for a primer, apply GacoPrime LVOC Primer at an approximate rate of 200 - 250 ft² / gal (18 - 23 m² / 3.8 L). Avoid puddling of primer on the surface. Target Wet Film Thickness (WFT) is 6 - 8 mils. Apply through one of the following methods:
 - a. BRUSH: Use solvent resistant brush and apply.
 - b. ROLLER: Apply GacoPrime with a solvent resistant short nap roller (standard 3/8 in (10 mm) nap recommended).
 - c. SPRAY: Do not thin. Use pressure pot or airless sprayer to apply primer. Avoid puddling of primer on surface when spraying. This is a very low viscosity fluid, so a small tip size is recommended.
 - 1) CURING TIME: Allow appropriate amount of cure time before applying base / topcoats (approximately 2 hours depending on ambient temperature). The primer will dry to a slightly tacky film. Test the primer film by pressing firmly with a finger and removing. Properly dried film will be well bonded to the substrate. If the film is removed from the substrate allow further drying time.
 - 2) NOTE: Oxidized metal panels that have been treated with a rust-inhibiting primer as described in 3.2.E must be primed with two (2) coats of GacoPrime LVOC Primer.
- C. AT ALL SEAMS AND LAPS, CHOOSE ONE OF THE FOLLOWING:
 - 1. Apply GacoFlex S42 Series Elastomeric Silicone Roof Coating by brush or roller at a minimum width of 6 in (16 cm) centered on the seam at minimum rate of 1.5 gal / 100 ft² (5.7 L / 9.3 m²) to obtain a Wet Film Thickness (WFT) of 24 mils (approx. 200 LF / gal (61 LM / 3.8L)). Immediately embed a 4 in (100 mm) strip GacoFlex 66S Reinforcing Polyester Mesh into the wet coating until the Polyester Mesh is completely saturated. The Polyester Mesh must be smoothly applied without wrinkles, "fish mouths," blisters, or pin holes. Once the Coating with embedded Polyester Mesh is firm to the touch, apply another coat of GacoFlex S42 Series Elastomeric Silicone Coating at a minimum rate of 1.5 gal/ 100 ft² (5.75 L / 9.3 m²) to completely encapsulate the Polyester Mesh. Allow to cure for a minimum of 24 hours (longer in overcast or low humidity conditions) before applying GacoFlex S42 Series Elastomeric Silicone Coating topcoat.
 - 2. Install sacrificial tape (Scotch Blue or equivalent) over all horizontal seams. Apply GacoFlex SF4200 Seam Seal applied at a minimum of 4 in (102 mm) wide, crested and centered at the seam, with a minimum thickness at the center of 64 wet mils (approx. 70 LF / gal (23 LM / 3.8 L)). Allow to cure for a minimum of 4 hours (longer in overcast or low humidity conditions) before applying a topcoat of GacoFlex S42 Series Elastomeric Silicone Roof Coating.
 - 3. Install sacrificial tape (Scotch Blue or equivalent) over all horizontal seams. Apply GacoPatch Silicone Roof Sealant at a minimum of 4 in (102 mm) wide, crested and

centered at the seam, with a minimum thickness at the center of 64 wet mills (approx. 70 LF / gal (23 LM / 3.8 L)). Allow to cure for a minimum of 4 hours (longer in overcast or low humidity conditions) before applying a topcoat of GacoFlex S42 Series Elastomeric Silicone Roof Coating.

- D. SLEEPERS: Any units that are sitting on sleepers must be lifted so that the membrane underneath the units can be cleaned, primed, and coated. An approved slip sheet must be placed under the sleepers to protect the coating. If the units are not lifted off the deck so as to be able to accomplish this procedure, the untreated area will be excluded from the manufacturer's warranty.
- E. SILICONE COATING: Apply one (1) coat of GacoFlex S42 Series Elastomeric Silicone Roof Coating at the average rate of 1.75 gal / 100 ft² (6.6 L / 9.3 m²) to obtain 28 mil Wet Film Thickness (WFT) / 26 mil Dry Film Thickness (DFT). Coat all surfaces including expansion joint covers and flashings. At all edges, penetrations, and standing seams or other vertical corrugations, an extra pass must be applied.

3.4 FIELD QUALITY CONTROL

- A. Any variations from the specified limits found by the Applicator or owner's representative shall be corrected by the Applicator.
- B. MINIMUM DRY FILM THICKNESS (DFT): Gaco recommends adding a 10 % variance factor to meet the minimum Dry Film Thickness (DFT) mil requirement to qualify as a warrantable application. It is the Applicator's responsibility to calculate the amount of coating needed to obtain the minimum Dry Film Thickness (DFT) mil thickness.
- C. No traffic shall be permitted on the coated surface for a minimum of three (3) days. Damage to the surface by other trades shall not be the responsibility of the Applicator.

END OF SECTION 07 01 50.61

SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING

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. Modified bituminous sheet waterproofing, fabric reinforced – install at all locations where water can infiltrate through wall surface. This includes planters and retaining walls.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review waterproofing requirements including surface preparation, 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
 - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

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1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations for Waterproofing System: Obtain waterproofing materials, protection course, and drainage panels from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil- thick, polyethylene-film reinforcement, and with release liner on adhesive side.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

- a. Carlisle Coatings & Waterproofing Inc; CCW MiraDRI 860/861.
- b. GCP Applied Technologies Inc.; Bituthene 3000.
- c. Henry Company; Blueskin WP 200.
- d. W.R. Meadows, Inc; Mel-Rol.
- e. York Manufacturing, Inc; HydroGard.

2. Physical Properties:

- a. Tensile Strength, Membrane: 250 psi minimum; ASTM D 412, Die C, modified.
- b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
- c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970/D 1970M.
- d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836/C 836M.
- e. Puncture Resistance: 40 lbf minimum; ASTM E 154/E 154M.

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- f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
 - g. Water Vapor Permeance: 0.05 perm maximum; ASTM E 96/E 96M, Water Method.
 - h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D 5385.
- 3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

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. Primer: Liquid waterborne primer recommended for substrate by sheet-waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.
- F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch thick, predrilled at 9-inch centers.
- G. Protection Course: Extruded-polystyrene board insulation, unfaced, ASTM C 578, Type X, 1/2 inch thick or as indicated on drawings.

2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 sieve laminated to one side of the core; and with a vertical flow rate of 9 to 15 gpm per ft..
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Hydrotech, Inc.
 - b. Carlisle Coatings & Waterproofing Inc.
 - c. GCP Applied Technologies Inc.
 - d. Protecto Wrap Company.

2.5 INSULATION

- A. Insulation, General: Comply with Section 072100 "Thermal Insulation."

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 waterproofing.
1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates 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 substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.
- F. Bridge and cover isolation joints, expansion joints and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.
1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

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1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
- H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
 1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
- D. Two-Ply Application: Install sheets to form a membrane with lap widths not less than 50 percent of sheet widths, to provide a minimum of two thicknesses of sheet membrane over areas to receive waterproofing.
- E. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.
- F. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- G. Seal edges of sheet-waterproofing terminations with mastic.
- H. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.
- I. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.
- J. Immediately install protection course with butted joints over waterproofing membrane.
 1. Molded-sheet drainage panels may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

3.4 MOLDED-SHEET DRAINAGE-PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
 - 1. For vertical applications, install protection course before installing drainage panels.

3.5 INSULATION INSTALLATION

- A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch of projections and penetrations.
- B. On vertical surfaces, set insulation units in adhesive or tape applied according to manufacturer's written instructions.
- C. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.6 FIELD QUALITY CONTROL

- A. Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish daily reports to Architect.
- B. Prepare test and inspection reports.

3.7 PROTECTION, REPAIR, 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 board insulation and insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 13 26

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SECTION 07 18 00 - TRAFFIC COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes traffic coatings for the following applications:
 - 1. Pedestrian traffic areas at all exterior stairs, landings and 2nd floor balconies.
 - 2. Provide all labor, materials, equipment and supervision as necessary to install a fluid-applied, polymer-modified, cementitious pedestrian traffic topping over concrete surfaces, as shown on the project drawings and as outlined in this specification.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's technical data, application instructions, shop drawings and general recommendations for the waterproof co-polymer composition traffic topping waterproof surfacing system specified herein.
- B. Samples for initial selection purposes in form of manufacturer's recommended installation procedures for specific application parameters.
- C. Material certificates signed by manufacturer certifying that the waterproof co-polymer composition traffic topping waterproof surfacing system complies with requirements specified herein.
- D. Maintenance Instructions: Submit manufacturer's written instructions for recommended maintenance practices.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For traffic coatings to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Single-Source Responsibility: Obtain waterproof co-polymer composition traffic topping waterproof surfacing system materials, including primers, resins, hardening agents, and finish or sealing coats, from a single manufacturer.
- C. Mockups: Build mockups to set quality standards for materials and execution.
 - 1. Build mockup for each traffic coating and substrate to receive traffic coatings.
 - 2. Size: 200 sq. ft. of each substrate to demonstrate surface preparation, joint and crack treatment, thickness, texture, color, and standard of workmanship.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Apply traffic coatings within the range of ambient and substrate temperatures recommended in writing by manufacturer. Do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.
 - 1. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of substrate.
- B. Do not install traffic coating until items that penetrate membrane have been installed.

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace traffic coating that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Adhesive or cohesive failures.
 - b. Abrasion or tearing failures.
 - c. Surface crazing or spalling.
 - d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations:

1. Obtain traffic coatings from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- #### A. Material Compatibility:
- Provide primers; base coat, intermediate coat, and topcoat; and accessory materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

2.3 TRAFFIC COATING

- #### A. Traffic Coating:
- Manufacturer's standard, Troweled waterproof co-polymer composition traffic topping waterproof surfacing system, traffic-bearing, seamless, high-solids-content, cold liquid-applied, elastomeric, water-resistant membrane system with integral wearing surface for pedestrian traffic; according to ASTM C957/C957M.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Dex-O-Tex Dex-Flex as manufactured by Crossfield Products Corp.
2. Neogard; a division of Jones-Blair, Inc. Peda-Gard Aliphatic T.
3. Advanced Polymer Technology Corporation
4. or approved equal.

B. Materials:

1. The trowel applied waterproof co-polymer composition traffic topping waterproof surfacing system shall be composed of a co-polymer bondcoat, Synthetic rubber waterproof membrane, and cementitious co-polymer traffic topping surfacing.
 - a. All resin binders and all rubber emulsions shall be compounded with neoprene or polyacrylate co-polymer liquids and shall have a minimum synthetic rubber content of 35% when tested by the dry cup method.
 - b. Aggregate for traffic surface coating shall be suitably graded, fine trap-rock passing a #20 mesh sieve and retained on a #40 mesh sieve.
 - c. Fabric used as reinforcement for waterproof membrane shall be 7-1/2 oz. Woven polypropylene fabric.

2.4 PROPERTIES

- #### A. Colors:
- As indicated, or if not otherwise indicated, as selected by Architect from manufacturer's standard colors.

B. Physical Properties:

1. Provide a waterproof membrane system that meets or exceeds the listed minimum physical property requirements when tested according to the referenced standard test method in parentheses.
 - a. Thickness Minimum 1/8"

- b. Weight 1.5 lbs. psf.
- c. Bond Shear Strength (ASTM C482) Dry 77 psi.
Wet 62 psi.
- d. Coefficient of Static Friction Dry Rubber 1.03
Wet Rubber 0.99
Oily Rubber 1.09
- e. Fire Resistance (MIL-PRF-23003) Complies
- f. Resistance to Oil (MIL-PRF-23003) Complies
- g. Bacteria and Fungus Resistance (ASTM G22) No Growth/ no water penetration
- h. Hydrostatic Pressure Resistance (ASTM D751) 240 psi.
- i. Ozone Resistance (ASTM D1149) No cracking, orating or water penetration
(72 hrs. @ 100ppm 90°F)
- j. Dimensional Stability (ASTM D12040) <0.5%
- k. Elongation (ASTM D751) 1,1250%
- l. (membrane only unreinforced)
- m. Chloride Ion Penetration (15% NaCl @ 21 days) None

2.5 ACCESSORY MATERIALS

- A. Joint Sealants: Single-component polyurethane; ASTM C 920, Type S, Grade NS, Class 25, Use NT, A and M.
- B. Flashing Tape: 100 percent solids of synthetic resins, thermoplastics, and non-curing rubber with a built-in primer, bonded to a woven polyester backing.
 - 1. Thickness: Minimum 30 mils.
- C. Reinforcing Fabric: Stitchbond polyester fabric recommended in writing by traffic-coating manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the areas and conditions where the waterproof co-polymer composition traffic topping waterproof surfacing system is to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected by the Contractor in a manner acceptable to the Architect.
- B. Verify that substrates are visibly dry and free of moisture.
 - 1. Test for moisture content by method recommended in writing by traffic-coating manufacturer.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of traffic-coating work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Begin coating application only after substrate construction and penetrating work have been completed.
 2. Begin coating application only after minimum concrete-curing and -drying period recommended in writing by traffic-coating manufacturer has passed and after substrates are dry.
 3. Application of coating indicates acceptance of surfaces and conditions.
- E. Moisture Content: Evaluate level and emission of moisture in the substrate in accordance with ASTM D 7954, ASTM E 1869, and ASTM E 2170 or any other acceptable means to determine that moisture levels and emission rate are acceptable for application of specified waterproof deck covering system.

3.2 PREPARATION

- A. Clean and prepare substrates according to ASTM C1127 and manufacturer's written instructions to produce clean, dust-free, dry substrate for traffic-coating application. Remove projections, fill voids, and seal joints if any, as recommended in writing by traffic-coating manufacturer.
- B. Shot-blast, power scarify, grind, sand or clean as required to obtain optimum bond of traffic topping to concrete. Remove sufficient material to provide a sound surface free of laitance, glaze, efflorescence, and any bond-inhibiting curing compounds or form release agents. Remove grease, oil, and other penetrating contaminants. Repair damaged and deteriorated concrete to acceptable condition. Leave surface free of dust, dirt, laitance, and efflorescence. Provide clean, dry and neutral substrate for application of the traffic topping waterproof surfacing system in accordance with SSPC SP 13.
- C. Priming: Unless manufacturer recommends in writing against priming, prime substrates according to manufacturer's written instructions.
1. Limit priming to areas that will be covered by traffic-coating material on same day. Reprime areas exposed for more time than recommended by manufacturer.
- D. Schedule preparation work so dust and other contaminants from process do not fall on wet, newly coated surfaces.
- E. Mask adjoining surfaces not receiving traffic coatings to prevent overspray, spillage, leaking, and migration of coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and drains.
- F. Concrete Substrates: Mechanically abrade surface to a uniform profile acceptable to manufacturer, according to ASTM D4259. Do not acid etch.
1. Remove grease, oil, paints, and other penetrating contaminants from concrete.
 2. Remove concrete fins, ridges, and other projections.
 3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
 4. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D4258.
- G. Materials: Mix aqueous emulsions and aggregate when required as per manufacturer's instructions. Prepare materials according to waterproof membrane system manufacturer's instructions.

3.3 TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C1127 and manufacturer's written instructions.
- B. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.

3.4 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D4258.
 - 1. Comply with recommendations in ASTM C1193 for joint-sealant installation.
- B. Apply reinforcing strip in traffic-coating system where recommended in writing by traffic-coating manufacturer.

3.5 TRAFFIC-COATING APPLICATION

- A. Apply traffic coating according to ASTM C1127 and manufacturer's written instructions.
- B. Apply coats of specified compositions for each type of traffic coating at locations as indicated on Drawings.
- C. Start traffic-coating application in presence of manufacturer's technical representative.
- D. Verify that wet-film thickness of each coat complies with requirements every 100 sq. ft..
- E. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated.
- F. Cure traffic coatings. Prevent contamination and damage during coating application and curing.
- G. General: Apply each component of waterproof co-polymer composition traffic topping waterproof surfacing system according to manufacturer's directions to produce a uniform, monolithic surface of thickness indicated.
- H. Apply latex co-polymer bonding coat over entire area.
- I. Apply reinforced membrane at all vertical junctures. Embed polypropylene fabric into neoprene membrane liquid. up all vertical surfaces a minimum of 4". Treat all details and prepare for application of waterproof membrane.
- J. Apply aqueous neoprene rubber waterproof membrane solution with fabric reinforcement to entire area to be coated. Overlap all seams a minimum of 2 inches.
- K. Trowel apply two coats of polyacrylate co-polymer and fine aggregate composition to achieve a smooth, protective coat.
- L. Apply finish texture coat to desired finish. Apply additional texture coat to ramps and high use areas.

3.6 FIELD QUALITY CONTROL

- A. Final Traffic-Coating Inspection: Arrange for traffic-coating manufacturer's technical personnel to inspect membrane installation on completion.
 - 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- B. Waterproofing will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.7 PROTECTING AND CLEANING

- A. Cure waterproof neoprene co-polymer composition traffic bearing roof waterproof surfacing materials according to manufacturer's directions, taking care to prevent contamination during application stages and before completing curing process. Close application area for a minimum of 24 hours.
- B. Protect traffic coatings from damage and wear during remainder of construction period.
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 18 00

SECTION 07 21 00 - 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. Extruded polystyrene foam-plastic board.
 - 2. Glass-fiber blanket.
 - 3. Batt Sound (acoustical) insulation.
- B. Related Requirements:
 - 1. Section 09 29 00 "Gypsum Board"
 - 2. Section 07 54 19 "Polyvinyl-chloride (PVC) Roofing" for insulation specified as part of roofing construction.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 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 MANUFACTURES

- A. Products of the following manufactures form basis for design and quality intended.
1. Johns Manville Insulations, Denver, CO.
 2. Certainteed Corporation, Valley Forge, PA.
 3. Owens-Corning, Toledo, OH.
 4. Thermafiber Division of USG Corp, Wabash, IN.

2.2 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
1. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.3 GLASS-FIBER BLANKET

- A. Formaldehyde-Free Glass-Fiber Blanket, Reinforced-Foil Faced: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
1. Basis of Design: Johns Manville FSK-25, or equal conforming to the following:
 2. Thermal Resistance: R values to achieve overall assembly U-Factor no greater than applicable value in Table 140.3-B CEC unless noted otherwise in T-24 Energy report.
 3. Batt Size: As required to fully fill cavity width and height or length
 4. Thickness: As required to meet specified R-value without compression.
 5. Facing: Faced on one side with flame resistant foil facing.
 6. Flame Spread: Less than 25, ASTM E84
 7. Permeance: 0.05 perms, ASTM E 96.

2.4 BATT SOUND (ACOUSTICAL) INSULATION

- A. Sound Attenuation Insulation: ASTM C665, Type I; preformed glass fiber, formaldehyde-free, "Sound Control Batts", acoustical fiber glass insulation, by Johns Manville or equal. Conforming to the following:
1. Size: As required to fully fill cavity width and height.
 2. Thickness: 3-5/8" for 4" walls and 5-1/2" for 6" walls, minimum 10" thick between floors.
 3. Facing: Unfaced.
 4. Flame Spread: Less than 25, ASTM E84.
 5. Smoke Developed Rating: Maximum 50.
 6. Location: At all interior walls.

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2.5 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 - 1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - 2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.
- B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
 - 1. Angle: Formed from 0.030-inch- thick, perforated, galvanized carbon-steel sheet with each leg 2 inches square.
 - 2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.
- C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
 - 1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
 - a. Crawl spaces.
 - b. Ceiling plenums.
 - c. Attic spaces.
- D. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space as indicated between face of insulation and substrate to which anchor is attached.
- E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.6 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
 - 2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 - 5. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

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6. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
 - a. Exterior Walls: Set units with facing placed as indicated on Drawings.
 7. Batts Under Wood Roof Decks: Install foil-faced flanged-type insulation batts secured with spindle anchors. Staple flanges together at maximum 4" centers and seal joints at abutting vertical surfaces with a pressure-sensitive plastic tape. Provide 16 gauge galvanized string wires under batts wherever necessary to prevent sagging, stretched taut.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.5 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 07 21 00

SECTION 07 25 00 - WEATHER BARRIERS

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. Building wrap.
 - 2. Flexible flashing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

- A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont Safety & Construction; Tyvek CommercialWrap or a comparable product by one of the following:
 - a. Dorken Systems Inc.
 - b. Dow Chemical Company (The).
 - c. Kingspan Insulation Limited.
 - d. Ludlow Coated Products.
 - e. Raven Industries, Inc.
 - f. Reemay, Inc.

2. Water-Vapor Permeance: Not less than 20 perms per ASTM E 96/E 96M, Desiccant Method (Procedure A).
 3. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch wg when tested according to ASTM E 2178.
 4. Allowable UV Exposure Time: Not less than three months.
 5. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.
- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 FLEXIBLE FLASHING

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. DuPont (E. I. du Pont de Nemours and Company); DuPont Flashing Tape.
 - b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor Butyl Self Adhered Flashing.
 - c. Protecto Wrap Company; BT-25 XL.
 - d. Raven Industries Inc.; Fortress Flashshield.
 - e. Advanced Building Products Inc.; Wind-o-wrap.
 - f. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - g. Fiberweb, Clark Hammerbeam Corp.; Aquaflash 500.
 - h. Fortifiber Building Systems Group; Fortiflash 25.
 - i. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor Plus Self-Adhered Flashing.
 - j. MFM Building Products Corp.; Window Wrap.
 - k. Polyguard Products, Inc.; Polyguard JT-20 Tape.
 - l. Sandell Manufacturing Co., Inc.; Presto-Seal.
 2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.
- B. Primer for Flexible Flashing: Product recommended in writing by flexible flashing manufacturer for substrate.
- C. Nails and Staples: Product recommended in writing by flexible flashing manufacturer and complying with ASTM F 1667.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
 - 1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
 - 2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.
- C. Building Wrap: Comply with manufacturer's written instructions and warranty requirements.
 - 1. Seal seams, edges, fasteners, and penetrations with tape.
 - 2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
 - 1. Prime substrates as recommended by flashing manufacturer.
 - 2. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
 - 3. Lap flashing over water-resistive barrier at bottom and sides of openings.
 - 4. Lap water-resistive barrier over flashing at heads of openings.
 - 5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 07 25 00

SECTION 07 26 00 - VAPOR RETARDERS

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. Polyethylene vapor retarders.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

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

PART 2 - PRODUCTS

2.1 POLYETHYLENE VAPOR RETARDERS

- A. Polyethylene Vapor Retarders: ASTM D4397, 6-mil-thick sheet, with maximum permeance rating of 0.1 perm.

2.2 ACCESSORIES

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- B. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

- A. Place vapor retarders on side of construction indicated on Drawings.
- B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.
- D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 PROTECTION

- A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION 07 26 00

SECTION 07 54 30 – ADHERED THERMOPLASTIC (PVC) FELTBACK MEMBRANE ROOFING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Summary:

Install an adhered thermoplastic (PVC) feltback membrane roof system, including, but not limited to, primed gypsum cover board, PVC membrane flashings, PVC metal edge flashing, and other components to comprise a weathertight roof system. The roof system shall comply with the herein specified roofing manufacturer's standard written and detail requirements. Note: Sika Sarnafil products and system installation requirements have been utilized as the basis of design for this project.

B. System Description:

1. Remove and dispose of existing roof system; including all vertical flashings, penetration flashings and applicable sheet metal down to the structural plywood deck. All removal, hauling, and disposal procedures must be performed by a certified contractor and must meet or exceed all applicable Local and State requirements.
2. As applicable, remove asbestos containing materials (ACM) present in those components and areas of the building subject to the work of this project. The scope of the asbestos removal work shall be as required to comply with Local, State, and Federal regulations and standards. The Applicator shall obtain and pay for all licenses and permits associated with all asbestos work. The Applicator shall provide to the El Monte Union High School District (EMUHSD) Representative copies of all permits, certificates, and other related documents pertaining to the asbestos removal work.
3. As identified by the EMUHSD Representative, remove and dispose of all non-usable roof vents, roof top equipment and applicable curbs. Repair and/or replace plywood decking in accordance with Local building code requirements. Deck replacement shall match the same size and type as that of existing deck. 10 sheets of 4'x8' plywood replacement shall be included in the Base Bid price. Any required deck replacement beyond the included 10 sheets shall be reimbursed at the rate included on the project bid form. All deck replacement shall be verified by EMUHSD prior to replacement.
4. Over the properly prepared plywood roof deck areas install a single layer of 1/4" thick pre-primed gypsum cover board with fiberglass mat facer. The cover board shall be installed directly over the plywood roof deck and shall be secured to the wood deck using Factory Mutual approved heavy duty fasteners and high field strength plates at a rate of 12 attachment plates and fasteners per 4'x8' board (one (1) every 2.667 square feet). Perimeter and corner attachment rates must be increased in accordance with Factory Mutual Data Sheets 1-28/29 requirements.
5. Install a layer of 60-mil thermoplastic (PVC) feltback membrane (EnergySmart White). The membrane shall be installed directly over the gypsum cover board and shall be adhered using VOC compliant, water-based adhesive. The membrane shall meet or exceed Cool Roof Rating Council (CRRC) requirements for Title 24 compliance.

6. Install new PVC clad metal at perimeter edge locations. The new clad metal shall have a minimum four-inch (4") attachment flange, three-inch (3") minimum vertical face with additional one-half inch (1/2") hemmed "kick" at bottom edge. The vertical face dimension in all cases shall be equal to or greater than the existing metal flashing. The edge metal shall be secured to the structural plywood deck using approved galvanized-steel angular ring-shank nails at a spacing of four-inch (4") on-center, staggered. Install a continuous metal cleat (hook strip) and PVC membrane cover strip in accordance with the Roofing Manufacturer's standard written and detail requirements. Note: Install PVC clad metal covers at all vertical joints in accordance with Roofing Manufacturer's standard requirements. Color of PVC clad metal shall be "White" unless indicated otherwise.
7. Install new 24-Ga. "Kynar" coated GSM gutters and downspouts to match existing (color and dimension) at all existing gutter locations. The new gutters shall have a three-inch (3") wide flange for attachment to the structural plywood deck using galvanized-steel angular ring-shank nails at a spacing of six-inch (6") on-center. The face dimension of gutter shall be one inch (1") less the back dimension of gutter. One-inch (1") wide, 16-gauge GSM spacing straps are to be installed at 36" on-center. The straps are to provide a locking hook strip at face of gutter and shall be attached at the back, top edge of gutter using metal capped grommets fasteners set in approved urethane sealant. The strap is to be configured in a "U" shape to provide clearance for the clad metal edge without modification (refer to Item #8 below). Gutter end-laps are to be two-inch (2") minimum in direction of flow, sealed with approved urethane sealant and pre-painted pop-riveted to match color of gutter. Rivets are to be installed at two-inch (2") on-center spacing. The new gutters shall be fabricated with a four-inch (4") long vertical down shot sleeve which shall be tight-fitted into the new downspouts and internally sealed using Sikaflex 1a, or pre-approved equal one-part urethane sealant. Outside diameter of gutter down shot sleeve shall be 1/16 inch less inside diameter of the new downspout. Downspouts shall be 4"x 4" minimum with 16-gauge attachment straps at top, bottom and no greater than every 5' on-center attached with painted to match metal cap grommets fasteners.
8. Install new PVC membrane expansion-joint (EJ) flashing to replace existing EJ flashing between roof areas. Install new G410 adhered roof deck membrane fastened on both sides of expansion joint with membrane attachment bar and fasteners at 12" on-center. Roof deck membrane shall be carried through expansion joint with membrane bellied between membrane attachment bar and fasteners on either side of expansion joint. Place foam rod into membrane bellows and cover with flashing membrane carried past membrane attachment on both sides of foam rod and hot-air weld providing watertight assembly.
9. Install new PVC membrane expansion-joint (EJ) flashing to replace existing EJ flashing at base of upper gym roof. Install new G459 asphalt resistant flashing membrane over top of properly prepared existing parapet wall with membrane bellows between the roof and onto adjacent parapet wall carried up to the base of existing counter-flashing receiver. Wall flashing to include required membrane attachment on both sides of bellied membrane bellows between the roof and parapet wall. Terminate top of membrane wall flashing at the highest extent possible below the new or existing reglet and counter-flashing. Membrane bellows shall be sized to accommodate compatible and compressible foam rod with diameter one-and-a-half times larger than the EJ gap. Place foam rod into membrane bellows and cover with flashing membrane carried past flashing membrane attachment on both sides of foam rod and hot-air weld providing watertight assembly. Top of vertical wall flashing shall be fastened at top edge with manufacturer approved fastener and attachment bar at six inches (6") on-center prior to re-installing existing GSM counter-flashing skirt

10. Existing fiberglass reinforced aluminum coated parapet walls at the upper gymnasium roof are to remain in place above the existing sheet metal counterflashing. Any loose wall flashing is to be fastened in place using Factory Mutual approved board plates and concrete anchors to secure sufficiently to the concrete wall. Apply acrylic to asphalt primer over existing surface prior to any repairs or acrylic roof coating. Repair any voids, tears or deficiencies with 3-course treatment of Acrylic Flashing with Polyester Reinforcement. Install 3 gallons of Acrylic Elastomeric Reflective Coating (2 passes at 1.5 gallons per 100 square foot each) up and over the existing parapet wall. At the newly installed and sealed sheet metal counterflashing, install 3-course treatment of Acrylic Flashing with Polyester Reinforcement. Color acrylic base coat shall be gray, top-coat shall be white. Upon Completion, install new pre-finished, "Kynar" coated sheet metal coping at top of parapet wall (standard color selected by Architect) as outlined below.
11. Install adhered 60 mil PVC flashing membrane up and over the top of the perimeter parapet walls where indicated. Adhere new asphalt/oil resistant PVC flashing membrane to properly prepared parapet wall surface. At top outside edge of parapet wall, install new PVC clad metal edge flashing. The new clad metal shall have a minimum four-inch (4") attachment flange, four-inch (4.0") vertical face with three-quarter inch (3/4") hemmed "kick" at bottom edge. The edge metal shall be secured to the wood substrate using approved fastener screws at a spacing of six-inch (6") on-center, staggered. Install a continuous metal cleat (hook strip) and PVC membrane cover-strip in accordance with the Roofing Manufacturer's standard written and detail requirements and as indicated on project drawings. Membrane flashings color shall be white, clad metal color shall be "Lead Gray" or color selected by District from manufacturer's PVC clad metal color chart.
12. Install adhered 60 mil PVC flashing membrane at interior parapet wall. Remove existing GSM skirt flashings at existing reglet. Adhere new asphalt/oil resistant PVC flashing membrane over the properly prepared parapet wall surface carried up to the base of the existing reglet flashing. Terminate adhered membrane flashing with one-inch (1") wide extruded aluminum attachment bar fastened 12" on-center maximum spacing fastened through top of membrane and approved sealant. Install new 24 gauge GSM skirt flashing matching existing profile and attachment method. All exposed fasteners shall include metal-capped grommited heads. Note: New GSM counter-flashing will be required at bottom of sloped metal roofing transitions to vertical wall flashing.
13. Install adhered, fiberglass reinforced, 60-mil PVC flashing membrane at equipment and/or piping support curbs. Adhere new asphalt/oil resistant PVC flashing membrane encapsulating the equipment curb. Install new 24 gauge galvanized sheet metal (GSM) cap flashing over top of flashed support curb. Re-attach unistrut piping anchorage. Apply approved urethane sealant into pilot hole, install new anchors and reseal above GSM cap.
14. Install adhered 60 mil PVC flashing membrane at metal curbed ducting and exhaust fans. Adhered new asphalt/oil resistant flashing membrane over the properly prepared metal curb substrate carried up within one-half inch (1/2") of the duct joint or integral louver vents on side of curb. Terminate membrane flashing with 2-1/4" wide extruded aluminum termination bar with integral sealant shelf. Termination bar shall be fastened eight-inches on-center (8"o.c.) through the top portion of membrane and urethane sealant between the membrane and metal curb substrate with metal-capped grommited fasteners. Install approved and tooled urethane sealant at properly prepared and clean metal curb surface and top of termination bar sealant shelf.
15. At removable equipment curbs, install adhered 60-mil "asphalt-oil" resistant flashing membrane. Flashing membrane to be adhered to the properly prepared vertical substrate with

approved flashing adhesive and carried up, over the top and down one and a half inches (1.5") on inside of existing curb. Membrane shall be fastened 12" on center at inside of curb. Reinstall equipment to top of curb set in approved urethane sealant and secure to curb using increased diameter, metal-capped grommets fasteners at a spacing of eight inches (8") on-center. Where possible, use existing fastener holes when installing new fasteners. Seal any exposed fastener holes using approved urethane sealant.

16. At all non-removable equipment curbs, install adhered "asphalt-oil" resistant flashing membrane. Flashing membrane shall be adhered to properly prepared vertical substrate to the highest extent possible and terminated with 22-gauge GSM extender piece set in approved urethane sealant and fastened at 12" on center with metal-capped grommets fasteners.
17. Install 60-mil asphalt-oil resistant PVC flashing membrane at existing roof hatch curbs. The flashing membrane shall be adhered to the properly prepared vertical substrate using V.O.C. compliant adhesive. Membrane termination shall be performed using Roofing Manufacturer approved termination reglet with one-part urethane sealant as indicated and in accordance with manufacturer's requirements.
18. Replace all existing roof drain clamping rings, bolts and debris strainers with new matching components. Existing drain bowl and clamping ring flange shall be thoroughly cleaned prior to installing PVC flashing membrane and sealant. All primary and overflow roof drains to receive new asphalt/oil resistant flashing membrane target with one full tube of manufacturer approved urethane sealant between the new flashing membrane and drain bowl receiver flange. Flashing membrane target shall be hot-air welded to roof membrane and installed in accordance with manufacturer's "Clamping Ring Drain" flashing.
19. At all scupper locations, install new PVC clad metal inserts. The inserts shall extend continuous through the wall opening and shall terminate two-inches (2") beyond the outside face of wall, using approved urethane sealant to seal gap at outside edge of insert. Scupper insert installation shall be in accordance with Manufacturer, SMACNA, and local building code requirements. Existing GSM leader-head and downspouts shall remain and be reused. Install stainless steel wire mesh over top of leader-head to prevent debris from entering top of leader-head.
20. All open (soil, vent, etc.) pipes shall be flashed utilizing "Vent Stack" detail with PVC membrane cap carried into top of vent pipe. Note: The use of clamps for membrane termination will not be accepted at open (non-connected) pipes.
21. All connected (conduit, gas, etc.) pipes will be flashed utilizing PVC membrane pipe flashing detail with additional 60 mil fiberglass reinforced PVC membrane storm collar set in approved sealant and clamped in place with stainless steel pipe clamp covering the primary pipe flashing.
22. Remove and dispose of all existing low-profile vents. At the existing openings, install new, 24-Ga. GSM "China Vent" and perform PVC membrane flashing as required. Note: The top (cap) of the new China Vent shall extend a minimum of three-inches (3") below the opening at the top of the vent and include wire mesh at open vent top to prevent wildlife entry.
23. All "Hot-Pipe" penetrations shall be flashed in accordance with the Roofing Manufacturer's temperature separation requirements. An acceptable metal sleeve, insulation, and rain collar are required to separate PVC flashing membrane from hot pipe, minimum two-inch (2") separation. Use high temperature sealant at rain collar and hot pipe location.

24. All angle-iron support legs shall receive a 60-mil PVC flashing membrane, fully encapsulated 45-degree top-angled wood block. The encapsulated block shall be installed at the inside base of angle-iron and shall be set in a full "bed" application of one-part urethane sealant. Install PVC flashing membrane over block and angle-iron in accordance with Roofing Manufacturer's written and detail requirements. Note: Pitch-pans will not be allowed on this project.
25. Only at locations where membrane flashing is not possible, install liquid flashing. Surface preparation includes cleaning the surface of penetration to clean bright steel and/or void of any surface contamination. Apply primer, base coat, reinforcement fleece and topcoat of liquid flashing in accordance with manufacturer's instructions.
26. Reseal existing equipment anchors on sheet metal covered equipment platforms. Remove existing anchors, install approved urethane caulking/sealant in pilot hole and install new threaded anchors (oversize when possible). Seal top of anchors with approved sealant.
27. At all inside and outside corner locations, install prefabricated membrane flashings only.
28. At all rooftop electrical conduit, condensate piping, gas piping, etc., install new, prefabricated thermoplastic pipe supports as manufactured by Miro Industries, or pre-approved equal. The pipe supports shall be positioned at a maximum spacing as required allowing for continuous four-inch (4") clearance above the finished roof surface. Properly secure the conduit/piping to the pipe support using approved metal straps.
29. At parapet wall locations that include sheet metal wall coping terminating against plaster, install new GSM saddle. Remove existing plaster sufficiently to allow installation of new GSM saddle tucked under existing underlayment and carrying over top of parapet wall. Following installation of new saddle, install new self-adhered bituminous flashing membrane and plaster surface blended and painted to match existing adjacent plaster surface.
30. Replace existing GSM sheet metal coping with new "Kynar" coated GSM coping. Install adhered PVC flashing membrane over areas without new roof flashing or acrylic wall coating. New coping shall be secured with continuous 22-gauge GSM hook strip at outside face. Inside face of coping shall be secured with metal cap grommited fasteners at 12" o.c. maximum spacing. Color of new coping shall be selected by Architect from standard "Kynar" color chart.
31. At locations with ladder, piping or unistrut is attached to the wall, remove existing anchors and perform flashing work as indicated above. Install additional membrane protection layer, add sealant at fastener pilot hole prior to resetting the equipment and seal the fastener upon completion.
32. Replace existing eyebolts at guy-wire piping supports with welded watertight stanchion with eye loop. Flash new stanchion with membrane pipe flashing at indicated in item #20 above.
33. Install 79-mil PVC walkway tread (Dark Grey color) at locations matching existing walkway layout, two serviceable sides of regularly maintained HVAC equipment, under ballast secured satellite dishes and three open sides of roof hatches. The walkway tread shall be installed in accordance with the Roofing Manufacturer's standard written and detail requirements.

34. Perform all flashing and detail work in strict accordance with the roofing manufacturer's standard written and detail requirements (as indicated within the project detail drawings and/or specification requirements, those specific project requirements shall supersede any corresponding minimum/standard requirements).

C. Work Included:

The work includes but is not necessarily limited to the installation of:

1. Existing Roof Removal
2. Substrate Preparation.
3. Gypsum Cover Board.
4. Cover Board Attachment Plates and Fasteners
5. Flashing Membrane Adhesive.
6. Roof Membrane Adhesive.
7. Membrane Attachment Bars & Fasteners.
8. Thermoplastic (PVC) Feltback Roof Membrane.
9. Thermoplastic (PVC) Flashing Membrane.
10. Metal Flashings.
11. Acrylic Primer and Roof Coating.
12. Sealants.
13. Roof Drains.
14. Sheet metal coping, counterflashing, gutter and downspouts.
15. Equipment Access/Walkway Tread.
16. Prefabricated Pipe Supports (Miro Industries).
17. Plaster wall repair.

1.2 QUALITY ASSURANCE

- A. Request for Information (RFI): To resolve conflicts or lack of definition that may create construction problems, Bidders for the Work of Section 07543 shall submit a written RFI to Architect/EMUHSD at least 15 days before Bids are due for any conflicts or omissions regarding the Work of this Section should they exist.
- B. Pre-Roofing Conference and Inspection: After approval of submittals but prior to beginning installation of Work of this Section, the Owner's Representative shall hold a meeting at the site attended by the Roofing Applicator, Sheet Metal, Painting, and related Subcontractors, and the Roofing Material Manufacturer to describe in detail the roof system(s) to be installed and to establish agreement, coordination, and responsibilities among the involved trades.
- C. The roofing system shall be applied only by an Applicator authorized by the specified Roofing Manufacturer prior to bid. The Applicator shall have a minimum of five (5) years documented experience with the Roofing Manufacturer. The Owner's Representative reserves the right to request a list of reference projects to verify Applicator's performance/work history. All references must be of similar size and scope, and must be within 100 miles of this project.
- D. The Roofing Manufacturer shall have directly produced the specified field and flashing membranes for the number of years equal to, or greater than that of the warranty term (20 years). The membrane shall have also maintained a consistent base formulation for the same number of years.
- E. The Roofing Manufacturer shall have a *Sustainable Product Certification* conforming to the requirements of *NSF/ANSI 347 – Sustainability Assessment for Single Ply Roofing Membranes*. Minimum certification level established for this project is: *Platinum*.

- F. Use only a Manufacturer who has initiated a post consumer recycling program and can demonstrate a minimum of five projects where the existing PVC membrane has been removed and recycled into new roofing membrane or PVC components.
- G. Membrane Manufacturer must have *Recycled Content Certification* from UL (Underwriters Laboratories) Environment.
- H. Membrane thickness stated in this document refers to waterproofing membrane PVC polymer thickness. Polyester felt backing is always in addition to the required membrane thickness and is measured in weight per square yard. The required weight for felt backing is nine ounces per square yard (9-Oz./Yd²). This is a non-negotiable minimum requirement.
- I. Unreinforced or polyester reinforced membranes are prohibited.
- J. Re-labeled / re-packaged ("Private-labeled") primary and flashing membranes will not be accepted.
- K. Membrane Manufacturer must have ISO 14001 Certification and a Responsible Care Program in-place with current good standing status.
- L. Membrane Manufacturer must not require the use of membrane cut edge sealant at any location. This is a maintenance item that the Owner does not accept.
- M. The Manufacturer shall provide interim and final roof inspection from a directly employed dedicated team of experienced inspectors. Sales personnel may not be used for onsite inspection of installations.

1.3 PRE-INSTALLATION MEETING

- A. Arrange for a Pre-Installation Meeting between the Applicator, Owner's Representative, General Contractor, Roofing Manufacturer's Representative, and related trades to be held at least two (2) weeks prior to the beginning of roof system installation.
- B. Review contract documents, manufacturer's instructions, project conditions, and proposed methods and procedures related to installation.
 - 1. Identify conditions that would be detrimental to proper installation.
 - 2. Review special details, corner conditions, drainage patterns, penetrations and similar conditions of adjacent construction that will affect or impact surface preparation and installation operations.
 - 3. Review substrates and surfaces to receive materials in order to verify compliance with specified requirements, and with manufacturer's substrate tolerance recommendations and surface preparation requirements, including flatness, levelness, damage and imperfections, and quality of attachment to structure.
 - 4. Review limitations of floor and roof decks for structural loading both during and after installation.
- C. Review governing regulations and specified requirements for certificates, inspection, reports and closeout submittals.

- D. Review sequence of installation, finalize construction schedule, and verify availability of materials, installer's personnel, equipment and facilities necessary to make progress and avoid delays.
- E. Review temporary protection procedures required to be followed to provide protection of stored and installed products and accessories both during and after installation.
- F. Owner's Representative shall record significant meeting discussions, agreements and disagreements, including required corrective measures and actions to be taken before work begins. Distribute copy of minutes to Owner's Authorized Representative, to each party present, and to parties who should have been present no later than 3 business days following the meeting.
- G. Do not proceed with installation until all attendees, including all parties who should have been present, provide written acknowledgement of receipt and agreement to the conditions and requirements as described in the "Meeting Minutes". If disagreements cannot be successfully resolved, initiate necessary actions to remove impediments to execution of the Work and reconvene meeting at earliest available date to resolve outstanding disagreements.

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. The applicator shall submit evidence that the proposed roof system meets local building code requirements and has been tested and approved or listed by the following test organizations.
 - 1. ASCE/SEI 7 and SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems".
 - a. Corner Design Uplift Pressure: 100 lbs. / Ft²
 - b. Perimeter Design Uplift Pressure: 70 lbs. / Ft²
 - c. Field-of-Roof Design Uplift Pressure: 40 lbs. / Ft²
 - d. Safety Factor 2.0
 - 2. Underwriters Laboratories, Inc.: Class A assembly
- D. Energy Performance:

Low-Slope Roofs: Provide roof system with an initial Solar Reflectance Index (SRI) of not less than 100 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency. Roof membrane (not post installation applied finish) shall comply with current California Title 24 Part 6 minimum 3-year aged solar reflectance of 0.63 and a minimum thermal emittance of 0.75 requirements.

1.5 SUBMITTALS:

- A. Submittals following award of project (utilizing the base specified system: Sika Sarnafil)

1. A list of each primary component to be used in the roof system and the Manufacturer's current product data and safety data for each component.
2. Sample copy of Roofing Manufacturer's warranty.
3. Sample copy of Contractor's warranty.
4. Letter from Roofing Manufacturer confirming that the Contractor is an authorized applicator of the specified roof system and confirmation of specified Quality Assurance and Performance Requirements.
5. Shop drawings for any deviations to project specification or construction details with written approval from Technical Department of Roof System Manufacturer. Deviations must be approved by Architect and Owner prior to installation.

B. Submittals of equals (15 days prior to bid date)

Submit proposed equals to be considered for use on this project no less than fifteen (15) days prior to bid date. Proposed roof systems which have been reviewed and accepted will be listed in an addendum prior to bid date; only then will roof systems be accepted at bidding. All below referenced letters must be original, wet-ink signed by the proposed Roofing Manufacturer's Technical Director/Manager. Submittals shall include the following:

1. Two 12 inch x 12 inch membrane samples and two samples of each component to be used in the roofing system.
2. Manufacturer's specification matching the herein specified requirements for all Sub-Sections as described. The Manufacturer shall also provide written confirmation that all detail and flashing conditions will be installed in strict accordance with the OWNER'S Standards as indicated within this specification and otherwise stated within the Contract Documents. Acceptance of any other, non-specified manufacturer's material(s) will not be deemed as acceptance for use of said manufacturer's minimum detail and/or installation requirements.
3. Letter from the proposed Roofing Manufacturer stating that the Manufacturer has a minimum of 20 years consistent experience in directly producing the proposed roof system. The letter shall also state that the proposed Manufacturer's membrane has maintained a consistent formulation for a minimum of 20 years.
4. Letter from the Cool Roof Rating Council (CRRC) stating that the proposed PVC membrane demonstrates the required Solar Reflectance Index requirements as stated in Section 1.4 D above. Submit listing as an approved product by the CRRC.
5. Letter from proposed Roofing Manufacturer describing the specified certified polymer thickness program. Included shall be a sample copy of the proposed Manufacturer's certificate for polymer thickness as specified.
6. Letter from the proposed Roofing Manufacturer confirming that it has been engaged in a post-consumer recycling program in compliance with the requirements as started in Section 1.2 F above. The proposed Roofing Manufacturer shall provide written proof that its post-consumer recycling program has achieved *UL Environmental* certification.
7. Complete list of material physical and mechanical properties for each membrane and component including; weights and thicknesses; ultimate elongation; puncture resistance; seam

peel strength; breaking strength; tear strength; dimensional stability; low temperature bend; and post-consumer recycle content.

8. Sample copy of specified warranties.
 - a. Manufacturer's 20-Year System Warranty (with no ponding/standing water exclusions).
 - b. Contractor's Two (2) Year Warranty
9. Letter from the proposed Roofing Manufacturer confirming that the Contractor is an authorized applicator of the proposed roof system per the requirements of Section 1.2 C listed above.

1.6 PRODUCT DELIVERY, STORAGE, and HANDLING:

All products delivered to the job-site shall be in the original unopened containers or wrappings bearing all seals and approvals. Handle all materials to prevent damage. Place all materials on pallets and fully protect from moisture.

1.7 JOB CONDITIONS

- A. PVC materials may be installed under certain adverse weather conditions but only after consultation with the Roofing Manufacturer, as installation time and system integrity may be affected.
- B. Uninterrupted waterstops shall be installed at the end of each day's work and shall be completely removed before proceeding with the next day's work.
- C. The Applicator shall conduct adhesion tests for cover board securement in accordance with the latest revision of the SPRI/ANSI pull test requirements to verify condition of deck and to confirm expected pull test values. Pull tests shall be performed a minimum of one (1) week prior to roof installation (Building M only).
- D. Arrange work sequence to avoid use of newly constructed roofing as a walking surface or for equipment movement and storage. Where such access is absolutely required, the General Contractor shall provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas. A substantial protection layer consisting of 1/2" plywood over polyester felt or 1/2" plywood over insulation board shall be provided for all new and existing roof areas which receive rooftop traffic during construction.
- E. The Applicator shall verify that all roof drain lines are functioning correctly (not clogged or blocked) before starting work. Applicator shall report any such blockages to the Owner's Representative for corrective action prior to beginning roof system installation.

1.8 BIDDING REQUIREMENTS

A. Bidders Responsibility

Bidders must have held their Roofing Contractors License (C39) for a minimum of five (5) years, with a continuous "Good-Standing" status to qualify to bid on this project. Any discrepancy between measurements and conditions listed within this specification, roof plans, and details, and those actually incurred on the job will be the responsibility of the Applicator.

1.9 WARRANTIES

A. Roofing Manufacturer's 20-Year Full System Warranty: 60 MPH Windspeed Coverage

Upon successful completion of all the work to the Roofing Manufacturer's and Owner's Representative's satisfaction, the 20 Year Full System Warranty shall be issued. The System warranty shall provide Non-Penal Sum (replacement cost) coverage for the roof membrane, all associated accessories that comprise the roof system, and all contractor labor for 20 years. The warranty shall be non-prorated, and shall not exclude ponding/standing water and no time limit shall be assigned for any such ponding/standing water during the warranty term. The warranty shall not exclude regular foot traffic on the roof membrane surface. Warranty shall not obligate the Owner to perform manufacturer defined maintenance work as a condition of continued warranty coverage.

B. Roofing Applicator/Contractor Two (2) Year Warranty

The Applicator/Contractor shall supply the Owner with a separate two year workmanship warranty. In the event any work related to roofing, flashing, or metal is found to be within the Applicator/Contractor warranty term, defective or otherwise not in accordance with the Contract Documents, the Applicator/Contractor shall repair that defect at no cost to the Owner.

C. "Early Bird" warranties are not to be issued as they will not be accepted by the Owner. The above specified Warranty will be issued only upon acceptance by the Roofing Manufacturer's Technical Department and the Owner's Representative's final approval.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The components of the adhered PVC feltback membrane roof system are to be products of Sika Sarnafil and/or products utilized by Sika Sarnafil to designate type, quality, and performance standards for this project.
- B. Substitutions: Upon pre-approval in accordance with Section 1.5 B above.

2.2 MANUFACTURER AND MEMBRANE

- A. Sika Sarnafil: G410 60-mil Guaranteed Thickness PVC with 9 oz. integral felt backing (Western Region Contact: (909) 942-0079).
- B. G410-60: Fiberglass reinforced membrane with an integral lacquer coating to repel dirt and sustain long-term solar reflectivity.
- C. Membrane shall be manufactured by Extrusion/Spread Coating process only, producing a monolithic membrane with fully encapsulated fiberglass reinforcement layer and a minimum of 27- mils of "weathering" polymer above the fiberglass reinforcement layer.
- D. Membrane shall conform to ASTM D4434 (latest revision), "Standard for Polyvinyl Chloride Sheet Roofing". Classification: Type II Grade I (fiberglass reinforcement).

- E. Roofing Manufacturer shall certify in writing that the product supplied for this project has a minimum polymer thickness of 60 mils. ASTM +/- tolerance for membrane thickness is not accepted.
- F. Membrane shall comply with California Building Code (CBC) Title 24, Section 118 requirements for solar reflectivity and emissivity. Manufacturer and membrane shall be listed in the Cool Roof Rating Council (CRRRC) product listing as outlined by the Department of Energy (DOE) and the Environmental Protection Agency (EPA).
- G. As manufactured, membrane shall conform to the following physical properties:
1. Color to be "EnergySmart" White.
 2. Thickness to be 60-mil (1.50 mm).

Property	ASTM Test Method	Minimum Physical Properties Requirements
Overall Thickness, mil	D751	60
Thickness Over Scrim, mil	--	27
Reinforcing Material	--	Fiberglass
Felt Weight, oz/yd ² (feltback membrane only)	--	9
Breaking Strength, lbf/in (N)	D751	80 (356)
Elongation at Break, % M.D.(1) & C.M.D. (1)	D751	250 & 220
Seam Strength, % of original (2)	D751	Pass
Retention of Properties After Heat Aging	D3045	--
Breaking Strength, % of original	D751	Pass
Elongation, % of original	D751	Pass
Tearing Resistance, lbf (N)	D1004	17.5 (78)
Low Temperature Bend, -40F(-40C)	D2136	Pass
Accelerated Weather Test (Florescent Light UV Exposure),Hours	G154	10,000
Cracking (7x magnification)		None
Discoloration (by observation)		Negligible
Crazing (7x magnification)		None
Linear Dimensional Change, %	D1204	-0.02
Weight Change After Immersion in Water, %	D570	1.9
Static Puncture Resistance, lbf (kg)	D5602	Pass
Dynamic Puncture Resistance, ft-lbf (J)	D5635	Pass
Recycle Content	9% Pre-consume, 1% Post-consumer	

*Results may differ based upon statistical variations depending upon mixing methods and equipment, temperature, application methods, test methods, actual site conditions, and curing conditions.

(1) M.D. = Machine Direction, C.M.D. = Cross Machine Direction

(2) Failure occurs through membrane rupture not seam failure.

2.3 FLASHING MATERIALS

A. Wall/Curb Flashing

1. G410 Membrane: Fiberglass reinforced membrane adhered to approved substrate using Stabond adhesive. Consult Sarnafil Product Data Sheets for additional information.
2. S327 Membrane: Polyester reinforced membrane for mechanically-attached flashings to approved substrate using Sarnastop.
3. Sarnaclad: PVC-coated, heat-weldable sheet metal. Sarnaclad is a 24 gauge, G90 galvanized metal sheet with a 20 mil (1 mm) unsupported PVC membrane laminated on one side. Consult Sarnafil Product Data Sheet for additional information.

B. Perimeter Flashing:

1. PVC Clad Metal Edge: PVC coated, heat-weldable sheet metal with continuous 22-gauge galvanized metal cleat. Sarnaclad is a 24 gauge, G90 galvanized metal sheet with a 20 mil (1 mm) unsupported PVC membrane laminated on one side.

C. Miscellaneous Flashing;

1. Aluminum Membrane Attachment Bar (Sarnastop)
2. Termination Reglet (Sarnareglet)
3. Pipe Boots (Sarnastack)
4. Universal Corners (Sarnacorners)
5. Flashing Membrane Adhesive (Stabond)

2.4 COVER BOARD

A. Georgia-Pacific DensDeck® Prime with EONIC Technology Cover Board or pre-approved equal: Impact and mold resistant, gypsum core fire barrier board with pre-coated glass-mat facers. Manufactured to meet the following requirements:

1. ASTM C 1177 (Consensus Standard).
2. Board Size: 1/4" x 4' x 8' or 1/2" x 4' x 8' as indicated or specified.
3. Weight (nominal): 1/4" = 1.2 Lbs./Ft2.
4. Surfacing: Primed Fiberglass Mat.
5. Flexural Strength, Parallel (ASTM C473): 100 lbf, minimum.
6. Flute Span (ASTM E661): 1/4" = 2-5/8 inches.
7. Permeance (ASTM E96): Greater than 17 perms.
8. R-Value (ASTM C518): 1/4" = 0.28.
9. Water Absorption (ASTM C473): Less than 5 percent of weight.
10. Surface Water Absorption (ASTM C473): Nominal 1.0 grams.
11. Compressive Strength (Applicable Sections of ASTM C472): Nominal 900 pounds per square inch.
12. Flame Spread/ Smoke Development (ASTM E84): Not more than 0 Flame Spread, 0 Smoke Development
13. Combustibility (ASTM E136): Noncombustible
14. Fire resistance rating (UL 790 and ASTM E108): Class A
15. Mold Resistance (ASTM D3273): Maximum Rating 10 of 10
16. Bending Radius: 1/4" = 4'.

B. Tapered Insulation (Crickets Only): 1/2" min. x 4' x 4' sloped rigid roof insulation panels composed of polyisocyanurate closed-cell foam core with coated glass facer laminated to both sides. Manufactured to meet the following requirements:

1. ASTM C1289-11, Type II, Class 2, Grade 2 (20 psi)
2. Zero Ozone Depletion Potential (ODP) from blowing agent (HCFC-free).

3. Long-Term Thermal Resistance (LTTR) R-Value based on ASTM 1303-11 and/or CAN/ULC-S770-09: Regardless of published values.
4. Facer Type: Black matt, fiber reinforced on both sides.
5. Board Size: 1/2" min. x 4' x 4'.
6. Tapered Insulation Slope: 1/2" per foot (double the primary slope) or as indicated.

2.5 ATTACHMENT COMPONENTS

A. Membrane Adhesive

1. V.O.C. Compliant Water Based Adhesive (Sarnacol 2121 Adhesive): Water-based adhesive used to attach the membrane to the horizontal or near-horizontal substrate. Consult Product Data Sheets for additional information.

B. Sarnafastener #12: Corrosion-resistant #12 fastener used with attachment plate to attach cover board to wood roof deck.

C. Sarnaplate: Used with Sarnafasteners to attach cover board to roof deck. Sarnaplate is a 3 inch square or round, 26 gauge stamping of SAE 1010 steel with an AZ 55 Galvalume coating.

D. Flashing Membrane Adhesive (Stabond Adhesive): Solvent-based reactivating-type adhesive used to attach the membrane to the flashing substrate. Consult Product Data Sheets for additional information.

E. Sarnafastener-XP: Corrosion-resistant #15 fastener used with membrane attachment bar to attach membrane to wood roof deck or curbed penetrations.

F. Membrane Attachment Bar (Sarnastop): One (1) inch wide, pre-punched aluminum membrane attachment bar. Used to attach PVC membrane at all perimeter and base-angle transitions. Consult Sarnafil Product Data Sheet for additional information.

2.6 WALKWAY PROTECTION

- A. Equipment Access/Walkway Tread (Sikaplan Walkway-20): Polyester reinforced, 79 mil/2.0 mm), weldable membrane with surface embossment. Used as a protection layer from rooftop traffic. Sarnatred is supplied in rolls of 3.25 feet wide and 32.8 feet long. Consult Sarnafil Product Data Sheet for additional information.

2.7 MISCELLANEOUS ACCESSORIES

A. Sealing Tape: Compressible foam with pressure-sensitive adhesive on one side. Used with metal flashings as a preventive measure against air and wind blown moisture entry.

B. Sarnasolv: Solvent cleaner used for the general cleaning of scuff marks, etc., from the Membrane surface.

2.8 SEALANTS

A. Depending on substrates, the following sealants are options for temporary overnight tie-ins:

1. Multiple layers of roofing cement and felt.
2. Mechanical attachment with rigid bars and compressed sealant.

2.9 EQUIPMENT / PIPING SUPPORTS

- A. Miro Industries, Inc.: Pillow Block or Strut Series piping supports installed over protection membrane to support roof top equipment or piping and protect new PVC Roof System.

2.10 MISCELLANEOUS FASTENERS AND ANCHORS:

- A. All fasteners, anchors, nails, straps, bars, etc. shall be post-galvanized steel, aluminum or stainless steel. Mixing metal types and methods of contact shall be assembled in such a manner as to avoid galvanic corrosion. Fasteners for attachment of metal to masonry shall be expansion type fasteners with stainless steel pins. All concrete fasteners and anchors must have a minimum embedment of 1-1/4 inch and must be approved by the fastener manufacturer. All miscellaneous wood fasteners and anchors used for flashings must have a minimum embedment of 1 inch and shall be approved by fastener manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION:

Report to Owner in writing all conditions that interfere with or prevent correct installation of work of this Section.

3.2 PRE-INSTALLATION MEETING

- A. Refer to Section 1.3 of this specification for meeting agenda requirements.

Discuss the following additional project aspects:

1. Safety
2. Set up
3. Construction schedule
4. Contract conditions
5. Coordination of the work
6. Structural Loading Limitations/Requirements
7. Review of Deck and/or Substrate Conditions

3.3 SUBSTRATE CONDITION

A. Applicator shall be responsible for acceptance or provision of proper substrate to receive new roofing materials.

- B. Applicator shall verify that the work done under related sections meets the following conditions:

1. Roof drains and/or scuppers have been installed and function properly.
2. Roof curbs, equipment supports, vents and other roof penetrations are properly secured and prepared to receive new roofing materials.
3. All surfaces are smooth and free of dirt, debris and incompatible materials.
4. All roof surfaces shall be free of water.

3.4 SUBSTRATE PREPARATION

The roof deck and existing roof construction must be structurally sound to provide support for the new roof system. The Applicator shall load materials on the rooftop in such a manner to eliminate risk of deck overload due to concentrated weight. The Owner's Representative shall ensure that the roof deck is secured to the structural framing according to local building code and in such a manner as to resist all anticipated wind loads in that location.

3.5 SUBSTRATE INSPECTION

- A. A dry, clean and smooth substrate shall be prepared to receive the new PVC membrane roof system.
- B. The Applicator shall inspect the substrate for defects such as excessive surface roughness, contamination, structural inadequacy, or any other condition that will adversely affect the quality of work.
- C. The substrate shall be clean, smooth, dry, free of flaws, sharp edges, loose and foreign material, oil and grease. Roofing shall not start until all defects have been corrected.
- D. All roof surfaces shall be free of water.
- E. PVC membrane shall be applied over compatible and accepted substrates only.

3.6 COVER BOARD INSTALLATION

- A. Cover board shall be fastened to the wood deck with manufacturer approved plate and heavy duty fastener at a rate according to ASCE 7-10, Factory Mutual Class 1-90 and the Roofing Manufacturer's requirements for attachment rates and patterns.

3.7 INSTALLATION OF PVC ROOF MEMBRANE:

- A. General
 - 1. Roof membrane is to be adhered according to the Roofing Manufacturer and Factory Mutual's requirements.
 - 2. Membrane overlaps shall be shingled with the flow of water where possible.
 - 3. Lay membrane rolls perpendicular to the direction of the roof slope.
 - 4. Tack welding of membrane full or half-width rolls for purposes of temporary restraint during installation on windy days is not permitted. Consult Roofing Manufacturer's Technical Department for further information.
 - 5. Hot-air weld overlaps according to roofing manufacturer's Take test cuts at least 3 times per day.
 - 6. Membrane flashings shall extend 2-1/2 inches past the membrane attachment bar and shall be hot-air welded to the field membrane as required.

3.8 HOT-AIR WELDING OF SEAM OVERLAPS :

- A. All field seams shall be hot-air welded using robotic welding equipment only (no hand-held welders). Seam overlaps should be 3 inches wide except for certain details.

3.9 MEMBRANE FLASHINGS:

- A. All flashings shall be installed concurrently with the roof membrane as the job progresses.

ADHERED THERMOPLASTIC (PVC) FELTBACK MEMBRANE ROOFING

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- B. Stabond Adhesive for Membrane Flashings: Stabond adhesive shall be applied according to instruction found on the Product Data Sheets. The bonded sheet shall be pressed firmly in place with a hand roller.
- C. All flashings shall extend a minimum of eight (8) inches above roofing level unless otherwise accepted in writing. No bitumen shall be in contact with the PVC membrane. All flashing membranes shall be mechanically fastened along the counter-flashed top edge with Sarnareglet or Sarnastop at eight or twelve inches (8"/12") on-center respectively.

3.10 PVC CLAD METAL BASE FLASHINGS:

- A. All metal flashings shall be fastened into metal or wood stud nailers or metal stud backing plates with manufacturer approved fasteners. Fasteners shall penetrate the nailer a minimum of 1 inch. Metal shall be installed to provide adequate resistance to bending and allow for normal thermal expansion and contraction.
- B. Adjacent sheets of PVC clad metal shall be spaced 1/4 inch apart. The joint shall be covered with two (2) inch wide aluminum tape. A four (4) inch minimum wide strip of PVC flashing membrane shall be hot-air welded over the joint.

3.11 METAL FLASHINGS

- A. Metal details, fabrication practices and installation methods shall conform to the applicable requirements of the following:
 - 1. Factory Mutual Loss Prevention Data Sheet 1-49 (latest issue).
 - 2. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) – latest issue.
- B. Metal joints shall be watertight. Metal flashings shall be securely fastened into metal stud or lumber backing. Fasteners shall penetrate the metal studs or lumber a minimum of one-inch (1"). Counter flashings shall overlap base flashings at least four (4) inches. Hook strips shall extend past metal studs and shall be securely sealed from air entry.

3.12 WALKWAY INSTALLATION

- A. Sikaplan Walkway-20: Apply a continuous coat of Stabond adhesive to the deck sheet and the back of Walkway in accordance with Sika Sarnafil's Technical requirements and press Walkway into place with a water-filled, foam-covered roller. Hot-air weld the entire perimeter of the Walkway to the field membrane. Walkway shall be installed at roof access points and two serviceable sides of regularly maintained HVAC equipment.

3.13 TEMPORARY CUT-OFF

- A. Flashings shall be installed concurrently with the roof membrane in order to maintain a watertight condition as the work progresses:
 - 1. Temporary waterstops shall be constructed to provide a 100% watertight seal.
 - 2. Stagger of the insulation joints shall be made even by installing partial panels of insulation.
 - 3. New membrane shall be carried into the waterstop sealant.

4. Waterstop shall be sealed to the deck and/or substrate so that water will not be allowed to travel under the new or existing roofing.
 5. When work resumes, the contaminated membrane shall be cut out.
 6. Sealant, contaminated membrane, insulation fillers, etc. shall be removed from work area and properly disposed of offsite. These materials shall not be used in new work.
- B. If inclement weather occurs while temporary waterstop is in place, Applicator shall provide the labor necessary to monitor the situation to maintain a watertight condition.
- C. If water is allowed to enter under the newly-completed roofing, the affected area shall be removed and replaced at the Applicator's expense.

3.14 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Owner's Representative.
- 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.

3.15 PROTECTION 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, provide written report, with copies to the Owner's Representative.
- 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 Contract Completion and according to warranty requirements.

END OF SECTION 07 54 30

SECTION 07 62 00 - 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Manufactured reglets with counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed low-slope roof sheet metal fabrications.
4. Formed wall sheet metal fabrications.
5. Formed equipment support flashing.

- B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 07 72 00 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
3. Section 07 54 19 - "Polyvinyl-Chloride (PVC) Roofing" for installation of sheet metal flashing and trim integral with roofing.

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

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

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Epoxy seam sealer.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of roof-penetration flashing.
8. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
9. Include details of special conditions.
10. Include details of connections to adjoining work.
11. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Verification: For each type of exposed finish.

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. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

B. Special warranty.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim like that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

1.8 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.
 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - 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 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

- C. FM Approvals Listing: Manufacture and install copings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Exterior visible sheet metal flashings: Semi-gloss acrylic over factory primed sheet metal.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, dead soft, fully annealed; with smooth, flat surface.
 - 1. Finish: ASTM A480/A480M, No. 2D (dull, cold rolled).
- D. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 coating designation; prepainted by coil-coating process to comply with ASTM A755/A755M.
 - 1. Surface: Smooth, flat.
 - 2. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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.
 - 3. Color: As selected by Architect from manufacturer's full range.
 - 4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
 - 1. Source Limitations: Obtain underlayment from single source from single manufacturer.

2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

- B. Slip Sheet: Rosin-sized building paper, 3 lb./100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - 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) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
 4. Fasteners for Zinc Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
- C. Solder:
 1. For Stainless Steel: ASTM B32, Grade Sn60, with acid flux of type recommended by stainless steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2-inch-wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

- H. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.
- I. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.
- J. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
 - 1. Source Limitations: Obtain reglets from single source from single manufacturer.
 - 2. Material: Galvanized steel, 0.028 inch (24 ga) thick minimum.
 - 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. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
 - 5. 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.
 - 6. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
 - 7. 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's lower edge.
 - 8. Finish: mill finish unless noted otherwise.

2.5 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
 - 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 2. 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.
 - 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
 - 4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
 2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- 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 cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- G. Seams:
1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- H. Do not use graphite pencils to mark metal surfaces.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop): Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch-wide, joint cover plates. Shop fabricate interior and exterior corners.
1. Joint Style: Overlapped, 4 inches wide.
 2. Fabricate from the following materials:
 - a. Galvanized Steel: 0.028 inch thick, prefinished.
- B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners weld watertight. Shop fabricate interior and exterior corners.
1. Coping Profile: As indicated on drawings.
 2. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
 3. Fabricate from the following materials:
 - a. Galvanized Steel: 0.040 inch thick, prefinished.

- C. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (24 ga) thick minimum.

- D. Flashing Receivers: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (24 ga) thick minimum.

2.7 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

- B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch thick.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch (0.71 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, 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.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

3.2 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

B. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lapp joints not less than 4 inches.

3.3 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder and welds.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.
9. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
 - 1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
 - 2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 - 3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
 - 1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
 - 2. Do not solder metallic-coated steel and aluminum sheet.
 - 3. Do not use torches for soldering.
 - 4. Heat surfaces to receive solder, and flow solder into joint.
 - a. Fill joint completely.
 - b. Completely remove flux and spatter from exposed surfaces.
 - 5. Stainless Steel Soldering:
 - a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
 - b. Promptly remove acid-flux residue from metal after tinning and soldering.
 - c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
- H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

3.5 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
 - 1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.

2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Copings:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending 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.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches over base flashing.
3. Lap counterflashing joints minimum of 4 inches.
4. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.

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 INSTALLATION OF WALL FLASHINGS

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

3.7 INSTALLATION OF MISCELLANEOUS FLASHING

A. Equipment Support Flashing:

1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
2. Weld or seal flashing with elastomeric sealant to equipment support member.

3.8 INSTALLATION 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 indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.9 CLEANING

- 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.

3.10 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. 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, as determined by Architect.

END OF SECTION 07 62 00

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Roof curbs.
 - 2. Roof hatches.
 - 3. Pipe and duct support.

- B. Related Requirements:

- 1. Section 05 50 00 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
 - 2. Section 07 62 00 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
 - 3. Section 23 05 48 "Vibration and Seismic Controls for HVAC" for special curbs designed to accommodate seismic and vibration controls.

1.3 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

- C. Sample Warranties: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

2.2 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.
- D. Material: Zinc-coated (galvanized) steel sheet, 0.052 inch thick.
- E. Construction:
 1. Curb Profile: Manufacturer's standard compatible with roofing system.
 2. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
 3. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange or by use of leveler frame.
 4. Insulation: Factory insulated with 1-1/2-inch-thick glass-fiber board insulation.
 5. Nailer: Factory-installed wood nailer under top flange on side of curb, continuous around curb perimeter.
 6. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

2.3 ROOF HATCHES

- A. Roof Hatches: Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis; a Cierra Products Inc. Company.
 - b. Bilco Company (The).
 - c. Bristolite Skylights.
 - d. J. L. Industries, Inc.
 - e. Milcor Inc.; a Gibraltar Company.
 - f. Nystrom, Inc.
 - g. O'Keeffe's Inc.
 - h. Wasco Products, Inc.
- B. Type and Size: Single-leaf lid, size as indicated on drawings.
- C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.
- D. Hatch Material: Zinc-coated (galvanized) steel sheet.
1. Thickness: Manufacturer's standard thickness for hatch size indicated.
 2. Finish: Factory prime coating.
- E. Construction:
1. Insulation: 1-inch-thick, glass-fiber board.
 2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
 3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 4. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
- F. Hardware: Spring operators, hold-open arm, stainless steel spring latch with turn handles, stainless steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
1. Provide two-point latch on lids larger than 84 inches.
- G. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
 2. Height: 42 inches above finished roof deck.
 3. Material: Steel tube.
 4. Post: 1-5/8-inch-diameter pipe.
 5. Finish: Manufacturer's standard baked enamel or powder coat.
 - a. Color: As selected by Architect from manufacturer's full range.

2.4 PIPE AND DUCT SUPPORTS

- A. Adjustable-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand base, pipe support, and roller housing, with stainless steel threaded rod designed for adjusting support height, accommodating up to 18 inch diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

2.5 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation and mill phosphatized for field painting where indicated.
 - 1. Mill-Phosphatized Finish: Manufacturer's standard for field painting.
 - 2. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.
- B. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.
- C. Steel Shapes: ASTM A36/A36M, hot dip galvanized according to ASTM A123/A123M unless otherwise indicated.
- D. Steel Tube: ASTM A500/A500M, round tube.
- E. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.
- F. Steel Pipe: ASTM A53/A53M, galvanized.

2.6 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Glass-Fiber Board Insulation: ASTM C726, nominal density of 3 lb./cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.
- C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- E. Underlayment:
 - 1. Slip Sheet: Building paper, 3 lb./100 sq. ft. minimum, rosin sized.
 - 2. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, 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.

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3. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
 - F. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
 - G. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
 - H. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
 - 2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Roof-Hatch Installation:
 - 1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
 - 2. Attach safety railing system to roof-hatch curb.
 - 3. Attach ladder-assist post according to manufacturer's written instructions.
- E. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.
 - 1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
- F. Seal joints with elastomeric sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.
- B. Clean exposed surfaces according to manufacturer's written instructions.
- C. Clean off excess sealants.
- D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 72 00

SECTION 07 84 13 - PENETRATION FIRESTOPPING

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. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
 - 3. Penetrations in smoke barriers.

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. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
- B. Regulatory Requirements: Conform to CBC for fire resistance ratings and surface burning characteristics.

- C. Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.
- D. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through penetration firestop systems are installed per specified requirements.
- E. A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- F. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1- hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- G. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- H. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
 - 1. Smoke Barrier Joints Air Leakage: Maximum 5 cfm per foot at 0.30 inches water gage pressure differential.
- I. Fire Resistant Joint Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- J. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- K. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- L. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- M. For those firestop applications that exist for which no UL tested system is available through a manufacturer, an engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to

installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.

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1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
 1. Sealant shall have a VOC content of 250 g/L or less.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- C. Install forming 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.
 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- D. Install fill materials by proven techniques to produce the following results:
 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 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 the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

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- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.3 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 07 84 13

SECTION 07 92 00 - JOINT SEALANTS

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. Silicone joint sealants.
 - 2. Nonstaining silicone joint sealants.
 - 3. Urethane joint sealants.
 - 4. Mildew-resistant joint sealants.
 - 5. Latex joint sealants.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Verification: For each kind 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. Provide cured samples of materials to be installed in colors selected by the Architect. Printed images will not be accepted in lieu of physical samples.
- C. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.
- D. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

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B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

1.6 FIELD 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. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from 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 JOINT SEALANTS, 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 joint-sealant manufacturer, based on testing and field experience.

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B. VOC Content: Sealants and sealant primers shall comply with the following:

1. Architectural sealants shall have a VOC content of 250 g/L or less.
2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
3. Sealants and sealant primers for porous substrates shall have a VOC content of 775 g/L or less.

C. Acceptable Products: See Joint Sealant Schedule.

D. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range. Color should match adjacent finishes.

2.2 SILICONE JOINT SEALANTS (FOODSERVICE AREAS)

- A. Single component silicone sealant chemically acceptable for application to surfaces and equipment that may contact edible products in establishments operating under the USDA federal meat and poultry inspection program

2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.
- B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT, A, G, O.
- C. Silicone, Nonstaining, S, NS, 100/50, T, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

2.4 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 35, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 35, Uses T and NT.
- B. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.

2.5 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

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2.6 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

2.7 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) or any other type, 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. 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. Provide self-adhesive tape where applicable.

2.8 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: Nonstaining, 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 performance of the Work.
- 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:

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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, 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. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion 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 by joint-sealant manufacturer or as indicated by 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 or primer 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 C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
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 in subparagraphs 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 profile per Figure 8A in ASTM C1193 unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform one test for each kind of sealant and joint substrate
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 - 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 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.

3.6 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior metal surfaces, including surrounds of windows and skylights.
 1. Joint Sealant: Silicone, Nonstaining, S, NS, 50, NT
 2. Acceptable products: Provide one of the following or approved equal.
 - a. GE Silicones SCS 2000 Series
 - b. Dow Corning 795
 - c. Tremco Spectrem 2
- B. Joint-Sealant Application: Exterior concrete, concrete masonry and plaster walls.
 1. Joint Sealant: Silicone, Nonstaining, S, NS, 100/50, T, NT
 2. Acceptable products: Provide one of the following or approved equal.
 - a. Dow Corning 790
 - b. GE Silicones Silpruf
 - c. Tremco Spectrem 1 or Spectrem 3
- C. Joint-Sealant Application: Exterior galvanized steel
 1. Joint Sealant: Urethane, S, NS, 35, T, NT
 2. Acceptable products: Provide one of the following or approved equal.
 - a. Sika Corporation Sika-Flex 1A
 - b. Sonneborn Building Products Div., ChemRex Inc. NP 1
- D. Joint-Sealant Application: Interior building sealant
 1. Joint Sealant: Acrylic latex or siliconized acrylic latex
 2. Acceptable products: Provide the following or approved equal.

- a. Pecora Corp "AC 20",
 - b. Sonneborn "Sonolac",
 - c. Tremco "Tremco Acrylic Latex 834"

- E. Joint-Sealant Application: Horizontal surfaces, including floor slabs and paving, and under door thresholds.
 - 1. Joint Sealant: Urethane, M, P, 25, T, NT
 - 2. Acceptable products: Provide one of the following or approved equal.
 - a. Sonneborn SL 2
 - b. Tremco THC 900/901

- F. Joint-Sealant Application: Sanitary sealant.
 - 1. Joint Sealant: Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT
 - 2. Acceptable products: Provide the following or approved equal.
 - a. Dow Corning Corp 786 Mildew Resistant
 - b. Sonneborn Sonolastic Omniplus

END OF SECTION 07 92 00

SECTION 08 11 13 - 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 08 Section "Flush Wood Doors".
2. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
3. Division 08 Section "Door Hardware".
4. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.

12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Shop Drawings: Include the following:
 1. Elevations of each door design.
 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of anchorages, joints, field splices, and connections.
 6. Details of accessories.
 7. Details of moldings, removable stops, and glazing.
 8. Details of conduit and preparations for power, signal, and control systems.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40" above sill) or UL 10C.
 1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
 2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 3. Smoke Control Door Assemblies: Comply with NFPA 105.

- a. Smoke "S" Label: Doors to bear "S" label and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
 - D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.
 - E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.
 - B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
 - C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.
- 1.6 PROJECT CONDITIONS
- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.
- 1.7 COORDINATION
- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- 1.8 WARRANTY
- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:
1. CECO Door Products (C).
 2. Curries Company (CU).
 3. Security Metal Products (SMP).

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.
- B. Exterior Doors (Energy Efficient): Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model, and ANSI/SDI A250.4 for physical performance level.
1. Design: Flush panel.
 2. Core Construction: Foamed in place polyurethane and steel reinforced core with no stiffener face welds.
 - a. Provide 18-gauge steel vertical reinforcements 6 inches apart and welded in place. Foamed in place polyurethane core is chemically bonded to all interior surfaces. No face welding is permitted.
 - b. Thermal properties to rate at a fully operable minimum U-Factor 0.374 and R-Value 2.53, including insulated door, Mercury thermal-break frame and threshold.
 3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
 4. Vertical Edges: Vertical edges to be mechanically interlocked with hairline seam. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
 5. 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

HOLLOW METAL DOORS AND FRAMES

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- attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".
 7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Design: Flush panel.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 2. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
 3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
 4. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 5. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- D. Manufacturers Basis of Design:
1. Curries Company (CU) - Polystyrene Core - 707 Series.
 2. Curries Company (CU) - Energy Efficient - 797 Mercury Series.

2.4 HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.
1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
 3. Manufacturers Basis of Design:
 - a. Curries Company (CU) – M Series.
- C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.
1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
 2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
 3. Manufacturers Basis of Design:

a. Curries Company (CU) - M Series.

- D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.
- E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

- 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
- 2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
- 3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.

- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

- C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 LOUVERS

A. Metal Louvers: 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.

- 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.

2.7 LIGHT OPENINGS AND GLAZING

- A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

- B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.
- C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.
- D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.8 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.9 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
 - 2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
 - 3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
 - 4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
- D. Hollow Metal Frames:
 - 1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling.

Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
 5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
 6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
 7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
 8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 9. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
 10. Door Silencers: Except on weather-stripped 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.

2.10 STEEL FINISHES

- A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
 4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs 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 08 11 13

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.

B. Related Requirements:

1. Section 08 80 00 "Glazing" for glass view panels in flush wood doors.
2. Section 08 11 13 "Hollow Metal Doors and Frames" for frames for wood doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of door. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

C. Samples: For factory-finished doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eggers Industries.
2. V.T. Industries.
3. Marshfield DoorSystems, Inc.
4. Approved Equal.

FLUSH WOOD DOORS

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2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.
- B. Adhesives: Do not use adhesives that contain urea formaldehyde.
- C. Composite Wood Products: Products shall be made without urea formaldehyde.
- D. WDMA I.S.1-A Performance Grade:
 - 1. Extra Heavy Duty: Unless otherwise indicated.
- E. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL 10C.
 - 1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 - 2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 - 3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- F. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- G. Structural-Composite-Lumber-Core Doors:
 - 1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf.
 - b. Screw Withdrawal, Edge: 400 lbf.
- H. Mineral-Core Doors:
 - 1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 - 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
 - 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:
 - 1. Grade: Premium, with Grade AA faces.
 - 2. Cut and species: White birch veneer finish.

3. Core: Structural composite lumber.
4. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.
5. Door thickness: 1-3/4 inches.

2.4 LIGHT FRAMES AND LOUVERS

- A. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.
- B. Metal Frames for Light Openings in Fire-Rated Doors: 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.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
- C. Openings: Factory cut and trim openings through doors.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 "Glazing."

2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors that are indicated to receive transparent finish.
- C. Transparent Finish:
 1. Grade: Premium.
 2. Finish: WDMA TR-6 catalyzed polyurethane.
 3. Staining: Clear factory finish – match existing wood doors if possible.
 4. Effect: Filled finish.
 5. Sheen: Satin.

FLUSH WOOD DOORS

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hardware: For installation, see Section 08 71 00 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - 1. Install fire-rated doors according to NFPA 80.
 - 2. Install smoke- and draft-control doors according to NFPA 105.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 08 14 16

SECTION 08 31 13 - ACCESS 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 access doors and frames for walls and ceilings.

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. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.
- C. Product Schedule: For access doors and frames.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Acudor Products, Inc.
 - 2. Babcock-Davis.
 - 3. Elmdor/Stoneman Manufacturing Company; a division of Acorn Engineering Company.
 - 4. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - 5. Larsens Manufacturing Company.
 - 6. Maxam Metal Products Limited.
 - 7. Milcor; Commercial Products Group of Hart & Cooley, Inc.

ACCESS DOORS AND FRAMES

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8. Nystrom, Inc.

B. Flush Access Doors with Exposed Flanges:

1. Description: Face of door flush with frame, with exposed flange and concealed hinge.
2. Locations: Wall.
3. Door Size: Minimum 30 by 30 inches and as required to access and service hidden component.
4. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
5. Frame Material: Same material, thickness, and finish as door.
6. Latch and Lock: Latch bolt, key operated with interior release.

C. Flush Access Doors with Exposed Flanges (Tiled walls):

1. Description: Face of door flush with frame, with exposed flange and concealed hinge.
2. Locations: Wall.
3. Door Size: Minimum 30 by 30 inches and as required to access and service hidden component.
4. Stainless-Steel Sheet for Door: Nominal 0.062 inch, 16 gage, No. 4 finish.
5. Frame Material: Same material, thickness, and finish as door.
6. Latch and Lock: Latch bolt, key operated with interior release.

D. Recessed Access Doors with Concealed Flanges:

1. Description: Door face recessed 5/8 inch for gypsum board infill; with concealed flange for gypsum board installation and concealed hinge.
2. Locations: Ceiling.
3. Door Size: Minimum 30 by 30 inches and as required to access and service hidden component.
4. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
5. Latch and Lock: Latch bolt, key operated with interior release.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Exposed Flanges:

1. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with exposed flange, self-closing door, and concealed hinge.
2. Locations: Wall.
3. Door Size: Minimum 30 by 30 inches and as required to access and service hidden component.
4. Fire-Resistance Rating: Not less than that of adjacent construction.
5. Uncoated Steel Sheet for Door: Nominal 0.036 inch, 20 gage, factory primed.
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock: Self-latching door hardware, operated by key.

2.4 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.
- D. Frame Anchors: Same material as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.5 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
 - 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
 - 1. For recessed doors with plaster infill, provide self-furring expanded-metal lath attached to door panel.
- E. Latch and Lock Hardware:
 - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
 - 2. Keys: Furnish two keys per lock and key all locks alike.

2.6 FINISHES

- A. 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: 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.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
- E. Stainless-Steel Finishes:
 - 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - 2. Polished Finish: No. 4 finish. Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. 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 substrates 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. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 31 13

SECTION 08 33 23 - OVERHEAD COILING DOORS

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. Insulated service doors (Exterior).
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.
 - 2. Section 260500 "Common Work Results for Electrical".
 - 3. Section 099000 "Painting and Coating."

1.3 REFERENCES

- A. ASTM A480/A480M-04; 2004 - Standard Specification for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- B. ASTM A653/A653M-03; 2003 - Standard Specification for Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
 - 3. Include description of automatic-closing device and testing and resetting instructions.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
 5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
 6. Include diagrams for power, signal, and control wiring.
- C. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
1. Curtain slats.
 2. Bottom bar with sensor edge.
 3. Guides.
 4. Brackets.
 5. Hood.
 6. Locking device(s).
 7. Include similar Samples of accessories involving color selection.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Special warranty.
- B. Maintenance Data: For overhead coiling doors 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 for both installation and maintenance of units required for this Project.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Wind Loads: Design door assembly to withstand wind/suction load of 20 psf (958 Pa) without damage to door or assembly components.
- B. Fire-Rated Door Assemblies: Complying with NFPA 80; listed and labeled by qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.
- C. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to California Building Code and ASCE/SEI 7.

2.3 EXTERIOR DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. C.H.I. Overhead Doors, Inc.
 - b. McKeon Rolling Steel Door Company, Inc.
 - c. Metro Door.
 - d. Overhead Door Corporation.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- C. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283 or DASMA 105.
- D. Curtain R-Value: 7.7 deg F x h x sq. ft./Btu. – minimum R value is 6.
 - 1. Fill slats with laid in place polyurethane insulation board complying with maximum flame spread and smoke developed indexes of 75 and 450 respectively, according to ASTM E84 or UL 723. Enclose and bond insulation within slat faces.
- E. Door Curtain Material: 18 gauge Galvanized steel. Finish: Hot-dipped galvanized in accordance with ASTM A653 and with baked on enamel primer coat and polyester finish coat.

- F. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height. Finish: Hot-dipped galvanized in accordance with ASTM A653 and with baked on enamel primer coat and polyester finish coat.
- G. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished to match door.
- H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- I. Hood: Match curtain material and finish.
 - 1. Shape: Round.
 - 2. Mounting: As indicated on Drawings.
- J. Locking Devices: Equip door with slide bolt for padlock.
- K. Directly driven, springless roll shall be steel tube with integral shafts, keyed on the Drive End and supported by self-aligning greaseable sealed bearings. Door shall not require any counterbalance device.
- L. Electric Door Operator:
 - 1. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower.
 - 2. Motor Exposure: Interior.
 - 3. Emergency Manual Operation: Chain type.
 - 4. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.
 - a. Sensor Edge Bulb Color: Black.
 - 5. Control Station(s): Where indicated on Drawings.
 - 6. Other Equipment: Audible and visual signals.
- M. Door Finish:
 - 1. Baked-Enamel or Powder-Coated Finish: Match Architect's control sample.

2.4 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.6 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 - 1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A653/A653M.

2.7 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

- A. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Release mechanism for motor-operated doors shall allow testing without mechanical release of the door. Automatic-closing device shall be designed for activation by the following:
 - 1. Replaceable fusible links with temperature rise and melting point of 165 deg F interconnected and mounted on both sides of door opening.

2.9 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.
 - 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location(s): Operator location indicated for each door.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.
 - 1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
 - 2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 - 3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.
 - 1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
 - 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency

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manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with the accessibility standard.

2.10 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

2.11 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.
- D. Power-Operated Doors: Install according to UL 325.

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3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
 - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 08 33 23

SECTION 08 51 13 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes interior aluminum windows.
- B. Related Sections:
 - 1. Section 08 80 00 "Glazing"
 - 2. Section 07 92 00 "Joint Sealants"
 - 3. Section 06 41 16 "Plastic Laminate Faced Architectural Cabinets"

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Sample warranties.

1.3 REFERENCES

- A. American Architectural Manufacturers Association (AAMA)
- B. American Society for Testing and Materials (ASTM)
- C. Aluminum Association (AA)
- D. National Wood Window & Door Association (NWWDA)
- E. California Association of Window Manufacturers (CAWM)

1.4 SYSTEM DESCRIPTION

- A. General: In addition to requirements shown or specified, comply with:
 - 1. Applicable provisions of AAMA Aluminum Storefront and Entrance Manual for design, materials, fabrication and installation of component parts.
- B. Design Requirements: Arcadia T200 Series (thermal) Heavy Commercial Fixed, Casement, Awning and Hopper Windows 2-inch depth. Hinged compression sealed aluminum windows. Suitable for outside or inside glazing.

- C. Performance Requirements: Each assembly shall be tested by a recognized testing laboratory or agency in accordance with specified test methods.
1. Conformance to F-AW55, C-AW80, AP-AW80 specifications in AAMA/NWWDA 101/I.S. 2/A440-8.
 - a. Air Infiltration: Accordance with ASTM E 283 at a static air pressure difference of 6.24 psf. Air infiltration shall not exceed .30 cfm per square foot.
 - b. Water Resistance: Accordance with ASTM E 331/ASTM E 547 at a static air pressure difference of 12 psf. No water leakage.
 - c. Uniform Load Structural: Aluminum window systems comply with AAMA/WDMA/CSA 101/I.S.2/A440-08, Voluntary specifications for aluminum windows. Guidelines for specified AW rated product.
 - d. Component testing: Accordance with procedures described in AAMA/NWWDA 101/I.S. 2/A440-08.
 - e. Forced Entry Resistance: All windows shall conform to CAWM 301-90.
 - f. Condensation Resistance Test: (CRF) when tested in accordance with AAMA 1503.1-88, the condensation resistance factor shall not be less than 51.
 - g. Thermal Transmittance Test: Accordance with AAMA 1503.1-88, (U-Value) not more than .59 BTU/hr/sf/°F.
 - h. Thermal Movements: Allow thermal movement resulting from the following maximum change (range) in ambient temperature.
 - 1) 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility:
1. Obtain entrances, storefronts, ribbon walls, window walls, curtain walls, window systems, and finish through one source from a single manufacturer.
- B. Provide test reports from AAMA accredited laboratories certifying the performances as specified in 1.4.
- C. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
1. Warranty Period:
 - a. System shall be warranted against failure and/or deterioration of metals due to manufacturing process for a period of two (2) years.

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PART 2 - PRODUCTS

2.1 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
- B. Each assembly shall be tested by a recognized testing laboratory or agency in accordance with specified test methods.
 - 1. Resistance to corner racking shall be tested by the dual moment corner joint strength test.
 - 2. Structural uniform load shall be tested in accordance with ASTM E 330.

2.2 ALUMINUM WINDOWS

- A. Acceptable Manufacturers:
 - 1. Arcadia, Inc., 3225 East Washington Blvd., Vernon, CA. Telephone 323/269-7300, Fax 323/269-7390.
 - 2. Or approved equal.
- B. Basis-of-Design:
 - 1. Arcadia, Inc., T200 Series (thermal)

2.3 MATERIALS

- A. Extruded aluminum profiles 6063-T6 alloy and temper (ASTM B221 G.S. 10A-T6).
- B. All framing members .125 minimum wall thickness.
- C. At Casement, Awning, and Hopper windows provide heavy-duty four bar hinges shall be stainless steel only, with asymmetric end caps, and adjustable limit stops. Lock and latches cast white bronze, US-25D finish.
- D. Weatherstrip EPDM bulb type conforming to ASTM D2000 AA515 and shall be keyed into extruded grooves.
- E. Back glazing two-sided adhesive, 15 lbs./ft.3 density, polyethylene tape. Glazing wedges shall be EPDM or Santoprene.
- F. Thermal barrier material poured-in-place two part polyurethane.
- G. Glass: Clear annealed glass, ASTM C 1036, Type 1, Class 1, q3.
 - 1. Kind: Fully tempered.

ALUMINUM WINDOWS

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- H. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
- I. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
 - 1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Glaze aluminum windows in the factory.
- C. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.
- D. Frame components mitered, reinforced extruded corner key, hydraulically crimped, and "cold welded."
- E. All ventilator extensions tubular, each corner mitered, reinforced extruded corner key, hydraulically crimped, and "cold welded."
- F. All corners weather sealed with an elastomeric sealant.

2.5 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions and verify substrate conditions are acceptable for product installation.
- B. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

ALUMINUM WINDOWS

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3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
- D. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- E. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- F. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

3.3 FIELD QUALITY CONTROL

- A. Contractors responsibility to make all necessary final adjustments to attain normal operation of each Window and its mechanical hardware.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 08 51 13

SECTION 08 71 00 – DOOR HARDWARE

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. Mechanical and electrified door hardware for:
 - a. Swinging doors.
- 2. Electronic access control system components, including:
 - a. Electronic access control devices.
- 3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.

- B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

- 1. Windows
- 2. Cabinets (casework), including locks in cabinets
- 3. Signage
- 4. Toilet accessories
- 5. Overhead doors

- C. Related Sections:

- 1. Division 01 Section "Alternates" for alternates affecting this section.
- 2. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
- 3. Division 09 sections for touchup finishing or refinishing of existing openings modified by this section.
- 4. Division 13 Section "Radiation Protection" for requirements for lead-lining for door hardware at openings indicated to receive radiation protection.
- 5. Division 26 sections for connections to electrical power system and for low-voltage wiring.
- 6. Division 28 sections for coordination with other components of electronic access control system.

1.3 REFERENCES

A. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

C. California Code of Regulations

1. Title 24: California Building Standards Code

1.4 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 requirements.
2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.

B. Action Submittals:

1. Product Data: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
 - a. Door Index; include door number, heading number, and Architects hardware set number.
 - b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
 - c. Type, style, function, size, and finish of each hardware item.
 - d. Name and manufacturer of each item.
 - e. Fastenings and other pertinent information.
 - f. Location of each hardware set cross-referenced to indications on Drawings.
 - g. Explanation of all abbreviations, symbols, and codes contained in schedule.
 - h. Mounting locations for hardware.
 - i. Door and frame sizes and materials.
 - j. Name and phone number for local manufacturer's representative for each product.
 - k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.
 - 1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.
 5. Key Schedule:
 - a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
 - 1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
 6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.
- C. Informational Submittals:
1. Qualification Data: For Supplier and Installer.
 2. Product Certificates for electrified door hardware, signed by manufacturer:

- a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 3. Certificates of Compliance:
 - a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
 - b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
 - c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
 4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
 5. Warranty: Special warranty specified in this Section.
- D. Closeout Submittals:
1. Operations and Maintenance Data : Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Name, address, and phone number of local representatives for each manufacturer.
 - d. Parts list for each product.
 - e. Final approved hardware schedule edited to reflect conditions as-installed.
 - f. Final keying schedule
 - g. Copies of floor plans with keying nomenclature
 - h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
 - i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.5 QUALITY ASSURANCE

- A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.
1. Where specific manufacturer's product is named and accompanied by "No Substitute," including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)
 - a. Where no additional products or manufacturers are listed in product category, requirements for "No Substitute" govern product selection.
 2. Where products indicate "acceptable manufacturers" or "acceptable manufacturers and products", provide product from specified manufacturers, subject to compliance with specified requirements and "Single Source Responsibility" requirements stated herein.

- B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
 - 4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
 - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
- C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.
- D. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
 - 2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- E. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
- F. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
- G. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
- H. Means of Egress Doors: Latches do not require more than 5 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.
- I. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf (22.2 N).
 - 2. Maximum opening-force requirements:

- a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.
- J. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.
1. Attendees: Owner, Contractor, Architect, Installer, **Owner's Security Consultant**, and Supplier.
 2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.
 - e. Address for delivery of keys.
- K. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Inspect and discuss preparatory work performed by other trades.
 3. Inspect and discuss electrical roughing-in for electrified door hardware.
 4. Review sequence of operation for each type of electrified door hardware.
 5. Review required testing, inspecting, and certifying procedures.
- L. Coordination Conferences:
1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
 - a. Attendees: Door hardware supplier, door hardware installer, Contractor.
 - b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.
 2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
 - a. Attendees: electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner, **Owner's security consultant**, Architect and Contractor.
 - b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
 - 1. Deliver each article of hardware in manufacturer's original packaging.
- C. Project Conditions:
 - 1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
 - 2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- D. Protection and Damage:
 - 1. Promptly replace products damaged during shipping.
 - 2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
 - 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- F. Deliver keys **and permanent cores** to Owner by registered mail or overnight package service.

1.7 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

F. Direct shipments not permitted, unless approved by Contractor.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Years from date of Substantial Completion, for durations indicated.

a. Closers:

1) Mechanical: 10 years. **30 years for LCN 4000**

b. Exit Devices:

1) Mechanical: 3 years.

2) Electrified: 1 year.

c. Locksets:

1) Mechanical: 3 years

2) Electrified: 1 year.

d. Continuous Hinges: Lifetime warranty.

e. Key Blanks: Lifetime

2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.9 REGULATORY REQUIREMENTS:

A. Locate latching hardware between 34 inches to 44 inches above the finished floor, per 2019 California Building Code, Section 11B-404.2.7.

1. Panic hardware: locate between 36 inches to 44 inches above the finished floor.

B. Handles, pull, latches, locks, other operable parts:

1. Readily openable from egress side with one hand and without tight grasping, tight pinching, or twisting of the wrist to operate. 2019 California Building Code Section 11B-309.4.

2. Force required to activate the operable parts: 5.0 pounds maximum, per 2019 California Building Code Section 11B-309.4.

C. Adjust doors to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors. As allowed per 2019 California Building Code Section 11B-404.2.9, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds.

1. Exception: exterior doors' pressure-to-open may be increased to 8.5-pounds if: at a single location, and one of a bank of eight leafs or fraction of eight, and one leaf of this bank is fitted with a low- or high-energy operator.

D. Adjust door closer sweep periods so that from an open position of 90 degrees, the door will take at least 5 seconds to move to a point 12 degrees from the latch, measured to the landing side of the door, per 2019 California Building Code Section 11B-404.2.8.

1. Spring hinges: adjust for 1.5 seconds minimum for 70 degrees to fully-closed.
- E. Smooth surfaces at bottom 10 inches of push sides of doors, facilitating push-open with wheelchair footrests, per 2019 California Building Code Section 11B-404.2.10.
 1. Applied kickplates and armor plates: bevel the left and right edges; free of sharp or abrasive edges.
 2. Tempered glass doors without stiles: bottom rail may be less than 10 inches if top leading edge is tapered 60 degrees minimum.
- F. Door opening clear width no less than 32 inches, measured from face of frame stop, or edge of inactive leaf of pair of doors, to door face with door opened to 90 degrees. Hardware projection not a factor in clear width if located above 30 inches and below 80 inches, and the hardware projects no more than 4 inches. 2019 California Building Code Section 11B-404.2.3.
 1. Exception: In alterations, a projection of 5/8 inch (15.9 mm) maximum into the required clear width shall be permitted for the latch side stop.
 2. Door closers and overhead stops: not less than 78 inches above the finished floor or ground, per 2019 California Building Code 11B-307.4.
- G. Thresholds: floor or landing no more than 0.50 inches below the top of the threshold of the doorway, per 2019 California Building Code Section 11B-404.2.5. Vertical rise no more than 0.25 inches, change in level between 0.25 inches and 0.50 inches: beveled to slope no greater than 1:2 (50 percent slope). 2019 California Building Code Section 11B-303.2 & ~.3.
- H. Floor stops: Do not locate in path of travel. Locate no more than 4 inches from walls, per DSA Policy #99-08 (Access).
- I. Pairs of doors with independently-activated hardware both leafs: limit swing of right-hand or right-hand-reverse leaf to 90 degrees to protect persons reading wall-mounted tactile signage, per 2019 California Building Code Section 11B-703.4.2.
- J. Door and door hardware encroachment: when door is swung fully-open into means-of-egress path, the door may not encroach/project more than 7 inches into the required exit width, with the exception of door release hardware such as lockset levers or panic hardware. These hardware items must be located no less than 34-inches and no more than 44-inches above the floor/ground. 2019 California Building Code, Section 1005.7.1.
- K. In I-2 occupancies, latch release hardware is not permitted to project in the required exit width, regardless of its mounting height, per 2019 California Building Code, Section 1005.7.1 at Exception 1.

1.10 MAINTENANCE

A. Extra Materials:

B. Maintenance Tools:

1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- 2.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturer" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
- E. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.2 MATERIALS

- A. Fasteners
 - 1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
 - 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 - 3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
 - 4. Install hardware with fasteners provided by hardware manufacturer.
- B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.
 - 1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
 - 2. Use materials which match materials of adjacent modified areas.
 - 3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.
- C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.
- D. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:
1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
 2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
 3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.
 4. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with sufficient number and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.3 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Ives 5BB series
2. Acceptable Manufacturers and Products: Hager BB series, McKinney TA/T4A series, Stanley FBB Series

B. Requirements:

1. Provide five-knuckle ball bearing hinges conforming to ANSI/BHMA A156.1.
2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
4. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins

8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
9. Doors 36 inches (914 mm) wide or less furnish hinges 4-1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.
10. Provide hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.
11. Provide mortar guard for each electrified hinge specified.

2.4 CONTINUOUS HINGES

A. Aluminum Geared

1. Manufacturers:
 - a. Scheduled Manufacturer: Ives.
 - b. Acceptable Manufacturers: Markar, Stanley.
2. Requirements:
 - a. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
 - b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum, with 0.25-inch (6 mm) diameter Teflon coated stainless steel hinge pin.
 - c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
 - d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
 - e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
 - f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
 - g. Install hinges with fasteners supplied by manufacturer.
 - h. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.5 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Rockwood, Trimco

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.6 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Rockwood, Trimco

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers and surface vertical rod exit device strikes. Factory-prep coordinators for vertical rod devices if required.

2.7 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage L9000 series

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
2. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
3. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
4. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide a request to exit (RX) switch that is actuated with rotation of inside lever.
5. Provide motor based electrified locksets with electrified options as scheduled in the hardware sets and comply with the following requirements:
 - a. Universal input voltage – single chassis accepts 12 or 24V DC to allow for changes in the field without changing lock chassis.
 - b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case
 - c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.

- d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
 - e. Request to Exit Switch (RX) –
 - 1) Modular Design – provide electrified locks capable of using, adding, or changing a modular RX switch without opening the lock case.
 - 2) Monitoring – where scheduled, provide a request to exit (RX) switch that detects rotation of the inside lever.
 - f. Connections – provide quick-connect Molex system standard.
 - g. UL Listed – 3 hour fire door
6. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
- a. Lever Design: Schlage **06A**.
 - b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.8 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product: Schlage ND Series

B. Requirements:

- 1. Provide cylindrical locks conforming to the following standards and requirements:
 - a. ANSI/BHMA A156.2 Series 4000, Grade 1.
 - b. UL 10C for 4'-0" x 10'-0" 3-hour fire door.
- 2. Cylinders: Refer to “KEYING” article, herein.
- 3. Provide cylindrical locksets exceeding the ANSI/BHMA A156.2 Grade 1 performance standards for strength, security, and durability in the categories below:
 - a. Abusive Locked Lever Torque Test – minimum 3,100 inch-pounds without gaining access
 - b. Cycle life - tested to minimum 10 million cycles per ANSI/BHMA A156.2 Cycle Test with no visible lever sag or use of performance aids such as set screws or spacers.
- 4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
- 5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
- 6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
- 7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
- 8. Provide electrified options as scheduled in the hardware sets.
- 9. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
 - a. Lever Design: Schlage Rhodes.

- b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.

2.9 AUXILIARY LOCKS

A. Deadlocks:

1. Manufacturers and Products:

- a. Scheduled Manufacturer and Product: Schlage L9000 series

2. Requirements:

- a. Provide mortise deadlock series conforming to ANSI/BHMA A156 and function as specified. Cylinders: Refer to "KEYING" article, herein.
- b. Provide deadlocks with standard 2-3/4 inches (70 mm) backset. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
- c. Provide manufacturer's standard strike.

B. Deadbolts:

1. Manufacturers and Products:

- a. Scheduled Manufacturer and Product: Schlage B600 series
- b. Acceptable Manufacturers and Products: Arrow N series, Best T series, Corbin-Russwin DL3000 series, Falcon D100 series, Sargent 480 series.

2. Requirements:

- a. Provide deadbolt series conforming to ANSI/BHMA A156 and function as specified. Cylinders: Refer to "KEYING" article, herein.
- b. Provide deadbolts with standard 2-3/4 inches (70 mm) backset. Provide 2-3/8 inches (60 mm) where noted or if door or frame detail requires. Provide deadbolt with full 1 inch (25 mm) throw, constructed of steel alloy.
- c. Provide manufacturer's standard strike.

2.10 EXIT DEVICES:

A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product: Von Duprin 99/33 series

B. Requirements:

- 1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, and UL listed for Panic Exit or Fire Exit Hardware. Cylinders: Refer to "KEYING" article, herein.
- 2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
- 3. Touchpad: Extend minimum of one half of door width. Match exit device finish, stainless steel for US26, US26D, US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. No plastic inserts are allowed in touchpads.

4. Provide exit devices with dead-latching feature for security and for future addition of alarm kits and/or other electrified requirements.
5. Provide flush end caps for exit devices.
6. Provide exit devices with manufacturer's approved strikes.
7. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
8. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
9. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
10. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
 - a. Lever Style: Match lever style of locksets.
 - b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.
11. Provide UL labeled fire exit hardware for fire rated openings.
12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
13. Provide electrified options as scheduled.

2.11 ELECTRONIC ACCESS CONTROL LOCKSETS AND EXIT DEVICE TRIM

- A. See Division 28:

2.12 CYLINDERS:

- A. Requirements:

1. Provide permanent interchangeable Small format interchangeable core SFIC. cylinders, compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Replaceable Construction Cores. OPTION if using temporary construction cores in IC core cylinder in either F/S or S/F.
 - a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
 - 1) 3 construction control keys
 - 2) 12 construction change (day) keys.
 - b. Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2.13 KEYING

- A. Provide cylinders/cores keyed into Owner's existing factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- B. Manufacturer:
 - 1. Best Lock Co. Provide permanent cores keyed into the existing key system
- C. Requirements:
 - 1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - a. Master Keying system as directed by the Owner.
 - b. Option: No Master Keying: Cylinders/cores only operated by change (day) keys.
 - 2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - 3. Provide keys with the following features:
 - a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 4. Identification:
 - a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Blind code marks shall not include actual key cuts.
 - b. Identification stamping provisions must be approved by the Architect and Owner.
 - c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE".
 - d. Failure to comply with stamping requirements shall be cause for replacement of keys involved at no additional cost to Owner.
 - e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
 - 5. Quantity: Furnish in the following quantities.
 - a. Change (Day) Keys: 3 per cylinder/core.
 - b. Option for LFIC or SFIC: Permanent Control Keys: 3.
 - c. Master Keys: 6.

2.14 DOOR CLOSERS OPTION:

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product: LCN 4040XP series.
 - 2. Acceptable Manufacturers and Products: No Substitute.
- B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch (38 mm) diameter with 3/4 inch (19 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.15 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Rockwood, Trimco

B. Requirements:

1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.16 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Rockwood, Trimco

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
 - a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 - b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 - c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.17 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers: Glynn-Johnson
2. Acceptable Manufacturers: Rixson, Sargent

B. Requirements:

1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.18 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Rockwood, Trimco

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.

3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.19 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: Zero International
2. Acceptable Manufacturers: National Guard, Pemko

B. Requirements:

1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Size of thresholds:
 - a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
 - b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.20 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Rockwood, Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.21 LATCH PROTECTORS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Rockwood, Trimco

- B. Provide stainless steel latch protectors of type required to function with specified lock.

2.22 COAT HOOKS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
 2. Acceptable Manufacturers: Rockwood, Trimco
- B. Provide coat hooks as specified.

2.23 FINISHES

- A. Finish: BHMA 626/652 (US26D); except:
1. Hinges at Exterior Doors: BHMA 630 (US32D)
 2. Continuous Hinges: BHMA 630 (US32D)
 3. Continuous Hinges: BHMA 628 (US28)
 4. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
 5. Protection Plates: BHMA 630 (US32D)
 6. Overhead Stops and Holders: BHMA 630 (US32D)
 7. Door Closers: Powder Coat to Match
 8. Wall Stops: BHMA 630 (US32D)
 9. Latch Protectors: BHMA 630 (US32D)
 10. Weatherstripping: Clear Anodized Aluminum
 11. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Where on-site modification of doors and frames is required:
1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
 2. Field modify and prepare existing door and frame for new hardware being installed.
 3. When modifications are exposed to view, use concealed fasteners, when possible.
 4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:

- a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
- c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 2. Custom Steel Doors and Frames: HMMA 831.
 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
- I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 1. Replace construction cores with permanent cores as indicated in keying section.
- J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.

- L. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- M. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- N. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- O. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- P. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- Q. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 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.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

- A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.7 DOOR HARDWARE SCHEDULE

A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

B. Hardware Sets:

HW SET: 01

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1HW SH 4.5 X 4.5 NRP	630	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
2	EA	PANIC HARDWARE	PA-AX-99-EO	626	VON
1	EA	MULLION STORAGE KIT	MT54	689	VON
1	EA	ELEC EXIT DEVICE TRIM	*AD-400-993R-70-MTK-RHO-B	626	SCE
1	EA	SFIC MORTISE CYL	80-132 (MULLION)	626	SCH
1	EA	SFIC CONST. CORE	80-035		SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	FLOOR STOP	FS18S	BLK	IVE
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28).

HW SET: 02

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1HW SH 4.5 X 4.5 NRP	630	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
2	EA	PANIC HARDWARE	PA-AX-99-EO	626	VON
1	EA	MULLION STORAGE KIT	MT54	689	VON
1	EA	ELEC EXIT DEVICE TRIM	*AD-400-993R-70-MTK-RHO-B	626	SCE
1	EA	SFIC MORTISE CYL	80-132 (MULLION)	626	SCH
1	EA	SFIC CONST. CORE	80-035		SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
2	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

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HW SET: 03

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW SH 4.5 X 4.5 NRP	630	IVE
1	EA	ELEC OFFICE LOCK	*AD-400-MS-50-MTK-RHO-B	626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28).

HW SET: 04

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW SH 4.5 X 4.5 NRP	630	IVE
1	EA	ELEC OFFICE LOCK	*AD-400-MS-50-MTK-RHO-B	✎ 626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL HEAD SEAL BEFORE CLOSER.

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28).

HW SET: 05

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	ELEC OFFICE LOCK	*AD-400-MS-50-MTK-RHO-B	✎ 626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	DOOR SEALS	PROVIDED BY ALUMINUM DOOR/FRAME MFG		B/O
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL HEAD SEAL BEFORE CLOSER.

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28).

HW SET: 06

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	ELEC OFFICE LOCK	*AD-400-MS-50-MTK-RHO-B	✈ 626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	DOOR SEALS	PROVIDED BY ALUMINUM DOOR/FRAME MFG		B/O
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

BEFORE CLOSER. *AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28).

HW SET: 07

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW SH 4.5 X 4.5 NRP	630	IVE
1	EA	PANIC HARDWARE	PA-AX-99-EO	626	VON
1	EA	ELEC EXIT DEVICE TRIM	*AD-400-993R-70-MTK-RHO-B	✈ 626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER & STRIKE.

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28).

HW SET: 08

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW SH 4.5 X 4.5 NRP	630	IVE
1	EA	PANIC HARDWARE	PA-AX-99-EO	626	VON
1	EA	ELEC EXIT DEVICE TRIM	*AD-400-993R-70-MTK-RHO-B	✓ 626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER & STRIKE.

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28).

HW SET: 09

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1HW SH 4.5 X 4.5 NRP	630	IVE
1	SET	AUTO FLUSH BOLT	FB31P/FB41P (AS REQ'D)	630	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQ'D	626	IVE
1	EA	ELEC LOCK	*AD-400-MS-70-MTK-RHO-B	✓ 626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	ASTRAGAL	43STST	STST	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28).

HW SET: 10

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	HINGE	5BB1HW SH 4.5 X 4.5 NRP	630	IVE
1	EA	PANIC HARDWARE	PA-AX-99-L-NL-06	626	VON
1	EA	MORTISE CYLINDER	20-061 ICX XQ11-948 (CYL DOGGING)	626	SCH
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER & STRIKE.

HW SET: 11

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 SH 4.5 X 4.5 NRP	630	IVE
1	EA	ELEC LOCK	*AD-400-MS-70-MTK-RHO-B	✓ 626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28).

HW SET: 12

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELEC LOCK	*AD-400-MS-70-MTK-RHO-B	✈ 626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	EA	GASKETING	328AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28).

HW SET: 13

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 SH 4.5 X 4.5 NRP	630	IVE
1	EA	ELEC LOCK	*AD-400-MS-70-MTK-RHO-B	✈ 626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28).

HW SET: 14

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
4	EA	HINGE	5BB1 SH 4.5 X 4.5 NRP	630	IVE
1	EA	ELEC LOCK	*AD-400-MS-70-MTK-RHO-B	626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28).

HW SET: 15 - Not Used

HW SET: 16

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 SH 4.5 X 4.5 NRP	630	IVE
1	EA	CLASSROOM SEC LOCK	L9071T 06A L283-711	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP SHCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

HW SET: 17

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 SH 4.5 X 4.5 NRP	630	IVE
1	EA	CLASSROOM SEC HOLDBK	L9077HD LLL 06A L283-711 L283- 150	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	DOOR PULL	VR900 SNB	630	IVE
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

HW SET: 18

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 SH 4.5 X 4.5 NRP	630	IVE
1	SET	CONST LATCHING BOLT	FB51P	630	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQ'D	626	IVE
1	EA	ELEC LOCK	*AD-400-MS-70-MTK-RHO-B	626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	ASTRAGAL	43SP	SP	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28).

HW SET: 19

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 SH 4.5 X 4.5 NRP	630	IVE
1	SET	CONST LATCHING BOLT	FB51P	630	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQ'D	626	IVE
1	EA	ELEC OFFICE LOCK	*AD-400-MS-50-MTK-RHO-B	✓ 626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	COORDINATOR	COR X FL	628	IVE
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	ASTRAGAL	43SP	SP	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28).

HW SET: 20

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 SH 4.5 X 4.5 NRP	630	IVE
1	SET	CONST LATCHING BOLT	FB51P	630	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQ'D	626	IVE
1	EA	CLASSROOM LOCK	L9070HD 06A	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	COORDINATOR	COR X FL	628	IVE
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	ASTRAGAL	43SP	SP	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

HW SET: 21

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA	PANIC HARDWARE	CDSI-PA-AX-99-EO	626	VON
1	EA	PANIC HARDWARE	CDSI-PA-AX-99-NL-OP-110MD	626	VON
1	EA	MULLION STORAGE KIT	MT54	689	VON
1	EA	SFIC MORTISE CYL	80-132 (MULLION)	626	SCH
2	EA	SFIC MORTISE CYL.	80-132 X XQ11-948 (DOGGING)	626	SCH
1	EA	SFIC RIM CYLINDER	80-159	626	SCH
4	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
2	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER

HW SET: 22

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	FIRE RATED REM MULLION	KR9954 STAB	689	VON
2	EA	FIRE EXIT HARDWARE	PA-AX-99-L-F-2SI-06	626	VON
1	EA	MULLION STORAGE KIT	MT54	689	VON
1	EA	SFIC MORTISE CYL	80-132 (MULLION)	626	SCH
4	EA	SFIC RIM CYLINDER	80-159	626	SCH
5	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
2	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER

HW SET: 23

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080HD LLL 06A L283-150	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	DOOR PULL	VR900 LLP SNB	630	IVE
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	EA	GASKETING	328AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

HW SET: 24

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 SH 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	L9080HD LLL 06A L283-150	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	DOOR PULL	VR900 SNB	630	IVE
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

HW SET: 25

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 SH 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	L9080HD LLL 06A L283-150	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	DOOR PULL	VR900 SNB	630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

HW SET: 26

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	PA-AX-99-L-F-2SI-06	626	VON
2	EA	SFIC RIM CYLINDER	80-159	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 27

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	PA-AX-99-L-F-2SI-06	626	VON
2	EA	SFIC RIM CYLINDER	80-159	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 28

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM DEAD LOCK	L9463HD L283-721 X ADA T-TURN	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	PUSH PLATE	8200 8" X 16" CFC	630	IVE
1	EA	PULL PLATE	8302 10" 4" X 16" CFT	630	IVE
1	EA	SURFACE CLOSER	4041 DEL TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	EA	GASKETING	328AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

HW SET: 29

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW SH 4.5 X 4.5 NRP	630	IVE
1	EA	CLASSROOM DEAD LOCK	L9463HD L283-721 X ADA T-TURN	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	PUSH PLATE	8200 8" X 16" CFT	630	IVE
1	EA	PULL PLATE	8302 10" 4" X 16" CFC	630	IVE
1	EA	SURFACE CLOSER	4041 DEL SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	GASKETING	429AA-S (HEAD & JAMBS)	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL HEAD SEAL BEFORE CLOSER.

HW SET: 30

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM DEAD LOCK	L9463HD L283-721 X ADA T-TURN	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	PUSH PLATE	8200 8" X 16" CFC	630	IVE
1	EA	PULL PLATE	8302 10" 4" X 16" CFT	630	IVE
1	EA	SURFACE CLOSER	4041 DEL TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

SIGNAGE AS REQUIRED

HW SET: 31

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM DEAD LOCK	L9463HD L283-721 X ADA T-TURN	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	PUSH PLATE	8200 8" X 16" CFT	630	IVE
1	EA	PULL PLATE	8302 10" 4" X 16" CFC	630	IVE
1	EA	SURFACE CLOSER	4041 DEL EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

SIGNAGE AS REQUIRED

HW SET: 32

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	KEYED PRIVACY	L9456T 06A L583-363 L283-722	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4041 DEL TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER
1	EA	COAT AND HAT HOOK	582	626	IVE

SIGNAGE AS REQUIRED

HW SET: 33

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	KEYED PRIVACY	L9456T 06A L583-363 L283-722	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4041 DEL EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER
1	EA	COAT AND HAT HOOK	582	626	IVE

SIGNAGE AS REQUIRED

HW SET: 34

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	KEYED PRIVACY	L9456T 06A L583-363 L283-722	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4041 DEL SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER
1	EA	COAT AND HAT HOOK	582	626	IVE

SIGNAGE AS REQUIRED

HW SET: 35

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70HD RHO	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4041 DEL TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

SIGNAGE AS REQUIRED

HW SET: 36

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70HD RHO	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4041 DEL SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

SIGNAGE AS REQUIRED

HW SET: 37

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 06A L583-363 L283-722	626	SCH
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4041 DEL ST-1630 TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER
1	EA	COAT AND HAT HOOK	582	626	IVE

SIGNAGE AS REQUIRED

HW SET: 38

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 06A L583-363 L283-722	626	SCH
1	EA	SURFACE CLOSER	4041 DEL EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER
1	EA	COAT AND HAT HOOK	582	626	IVE

SIGNAGE AS REQUIRED

HW SET: 39

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 06A L583-363 L283-722	626	SCH
1	EA	SURFACE CLOSER	4041 DEL TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER
1	EA	COAT AND HAT HOOK	582	626	IVE

SIGNAGE AS REQUIRED

HW SET: 40

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	ND75HD RHO XN12-035	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 41

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELEC LOCK	*AD-400-MS-70-MTK-RHO-B	✓ 626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28)

HW SET: 42

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	ND75HD RHO XN12-035	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 43

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	ND75HD RHO XN12-035	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 44

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	ND75HD RHO XN12-035	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 45

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE LOCK	ND53HD RHO	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
3	EA	SILENCER	SR64/SR65	GRY	IVE

HW SET: 46

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE LOCK	ND53HD RHO	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 47

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	ND75HD RHO XN12-035	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP ST-1630 TBSRT	689	LCN
1	EA	TOP JAMB MTG PLATE	4040XP-18TJ SRT	689	LCN
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 48

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	ND75HD RHO XN12-035	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 49

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	ND75HD RHO XN12-035	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	SET	DOOR SEALS	PROVIDED BY ALUMINUM DOOR/FRAME MFG		B/O

HW SET: 50

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	ND75HD RHO XN12-035	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP HEDA TBSRT	689	LCN
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	SET	DOOR SEALS	PROVIDED BY ALUMINUM DOOR/FRAME MFG		B/O

HW SET: 51

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	ND75HD RHO XN12-035	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP H TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 52

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	ND75HD RHO XN12-035	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP ST-1630 TBSRT	689	LCN
1	EA	TOP JAMB MTG PLATE	4040XP-18TJ SRT	689	LCN
1	SET	DOOR SEALS	PROVIDED BY ALUMINUM DOOR/FRAME MFG		B/O

HW SET: 53

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 54

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4041 DEL TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 55

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70HD RHO	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4041 DEL TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 56

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70HD RHO	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 57

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70HD RHO	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
3	EA	SILENCER	SR64/SR65	GRY	IVE

HW SET: 58

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70HD RHO	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64/SR65	GRY	IVE

HW SET: 59

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
3	EA	SILENCER	SR64/SR65	GRY	IVE

HW SET: 60

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	SET	CONST LATCHING BOLT	FB51P	630	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQ'D	626	IVE
1	EA	CLASSROOM LOCK	ND70HD RHO	626	SCH
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SURFACE CLOSER	4041 DEL SCUSH TBSRT	689	LCN
1	EA	DOOR HOLDER	PAH60	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	ASTRAGAL	43SP	SP	ZER
2	EA	SILENCER	SR64/SR65	GRY	IVE

HW SET: 61

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	SET	CONST LATCHING BOLT	FB51P	630	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQ'D	626	IVE
1	EA	CLASSROOM LOCK	ND70HD RHO	626	SCH
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SURFACE CLOSER	4041 DEL EDA TBSRT	689	LCN
1	EA	DOOR HOLDER	PAH60	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	ASTRAGAL	43SP	SP	ZER
2	EA	SILENCER	SR64/SR65	GRY	IVE

HW SET: 62

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
3	EA	SILENCER	SR64/SR65	GRY	IVE

HW SET: 63

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELEC LOCK	*AD-400-MS-70-MTK-RHO-B	626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28)

HW SET: 64

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	ELEC OFFICE LOCK	*AD-400-MS-50-MTK-RHO-B	626	SCE
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

*AD-400 LOCK/TRIM IS LISTED FOR TEMPLATING PURPOSES ONLY. TO BE PROVIDED, INSTALLED, AND COMMISSIONED BY THE SECURITY CONTRACTOR (DIV 28)

HW SET: 65

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 66

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	OH STOP & HOLDER	90H	630	GLY
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 67

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	ND75HD RHO XN12-035	626	SCH
2	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 68

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	AUTO FLUSH BOLT	FB31P/FB41P (AS REQ'D)	630	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQ'D	626	IVE
1	EA	CLASSROOM SECURITY	ND75HD RHO XN12-035	626	SCH
2	EA	SFIC CONST. CORE	80-035		SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4041 DEL SCUSH TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER
1	EA	ASTRAGAL	383AA	AA	ZER

HW SET: 69

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	SET	DOOR SEALS	PROVIDED BY ALUMINUM DOOR/FRAME MFG		B/O

HW SET: 70

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	DEADLOCK	L9460HD L583-363 L283-711	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	PUSH PLATE	8200 8" X 16" CFT	630	IVE
1	EA	PULL PLATE	8302 10" 4" X 16" CFC	630	IVE
1	EA	SURFACE CLOSER	4041 DEL HEDA TBSRT	689	LCN
1	EA	ARMOR PLATE	8400 36" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 71

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
2	EA	MANUAL FLUSH BOLT	FB458 (24" @ TOP)	626	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQ'D	626	IVE
1	EA	DEADLOCK	L9460HD L583-363 L283-711	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
2	EA	PUSH PLATE	8200 8" X 16" CFT	630	IVE
2	EA	PULL PLATE	8302 10" 4" X 16" CFC	630	IVE
1	EA	SURFACE CLOSER	4041 DEL HEDA TBSRT	689	LCN
2	EA	ARMOR PLATE	8400 36" X 1" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
2	EA	MEETING STILE	328AA-S	AA	ZER
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 72

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70HD RHO	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	ARMOR PLATE	8400 36" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER

HW SET: 73

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
2	SET	AUTO FLUSH BOLT	FB31P/FB41P (AS REQ'D)	630	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQ'D	626	IVE
1	EA	CLASSROOM SECURITY	ND75HD RHO XN12-035	626	SCH
1	EA	SFIC PERM CORE	MATCH EXISTING KEY SYSTEM	626	BES
1	EA	COORDINATOR	COR X FL	628	IVE
1	EA	SURFACE CLOSER	4040XP ST-1630 TBSRT	689	LCN
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	TOP JAMB MTG PLATE	4040XP-18TJ SRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	488SBK PSA (HEAD & JAMBS)	BK	ZER
2	EA	ASTRAGAL	47A	A	ZER

HW SET: 74

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	SET	CONST LATCHING BOLT	FB51P	630	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQ'D	626	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	626	SCH
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	328AA-S (HEAD & JAMBS)	AA	ZER
1	EA	ASTRAGAL	43SP	SP	ZER

HW SET: 75

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 SH 4.5 X 4.5 NRP	630	IVE
1	EA	EXIT LOCK	L9025 06A	626	SCH
1	EA	SURFACE CLOSER	4040XP SHCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA (OMIT @ OVERHANG)	AA	ZER
1	SET	DOOR SEALS	PROVIDED BY ALUMINUM FRAME MFG		B/O
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	103A-223 (OR PER SILL DETAIL)	A	ZER

INSTALL SEAL BEFORE CLOSER.

HW SET: 76

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	CONST LATCHING BOLT	FB51P	630	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQ'D	626	IVE
1	EA	STOREROOM LOCK	ND80HD RHO	626	SCH
1	EA	SFIC CONST. CORE	80-035		SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	FLOOR STOP	FS436/FS438 (AS REQ'D)	626	IVE
1	EA	GASKETING	328AA-S (HEAD & JAMBS)	AA	ZER
1	EA	ASTRAGAL	43SP	SP	ZER

END OF SCETION 08 71 00

SECTION 08 80 00 - GLAZING

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. Glass for doors, windows and storefront framing.
 - 2. Glazing sealants and accessories.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C1036.
- C. CBC: California Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- C. Glazing Accessory Samples: For sealants, in 12-inch lengths.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

- 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.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 - 2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 - 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 - 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 FIELD 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 glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.10 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to 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. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Guardian Glass; SunGuard.
 - 2. Pilkington North America.
 - 3. Viracon, Inc.
 - 4. Vitro Architectural Glass.
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the CBC and ASTM E1300.
 - 1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II and CBC 2406.
 - 1. Identification of Safety Glazing: Each pane of glazing shall be identified by a manufacturer's designation specifying who applied the designation, the manufacturer or installer and the safety glazing standard as required by CBC 2403.1. The identification shall be acid etched or sand blasted.
 - 2. Impact Test: Comply with CBC 2406.2.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic glass lites, properties are based on units with lites 6 mm thick.
 - 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - 3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
 - 4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 - 5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
 - 1. Minimum Glass Thickness for Exterior Lites: 6 mm.
 - 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
- B. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.
- C. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.
 - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
 - 2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
 - a. Spacer color: Black, unless noted otherwise.
 - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Sealant shall have a VOC content of 250 g/L or less.
 - 4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

- C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT.
- D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.
- E. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT.

2.7 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:
 - 1. AAMA 804.3 tape, where indicated.
 - 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; and complying with AAMA 800 for the following types:
 - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with 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:
 - 1. Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.
 - 2. Type recommended by sealant or glass manufacturer.
- D. Spacers:
 - 1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
 - 2. Type recommended by sealant or glass manufacturer.
- E. Edge Blocks:

1. Elastomeric material with a Shore A durometer hardness per manufacturer's written instructions.
 2. Type recommended by sealant or glass manufacturer.
- F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.9 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, 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 systems.
 3. Minimum required face and 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.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

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. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 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.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- I. 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.
- J. 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.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do meet glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces 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.

3.8 MONOLITHIC GLASS SCHEDULE

- A. Glass Type: Clear annealed float glass.
 - 1. Minimum Thickness: 6 mm.
- B. Glass Type: Clear fully tempered float glass.
 - 1. Minimum Thickness: 6 mm.
 - 2. Safety glazing required.

3.9 INSULATING GLASS SCHEDULE

- A. Glass Type: At all Exterior locations, tempered where indicated.
 - 1. Overall Unit Thickness: 1 inch.
 - 2. Minimum Thickness of Each Glass Lite: 6 mm.
 - 3. Outdoor Lite: Fully tempered float glass.
 - 4. Interspace Content: Air.
 - 5. Indoor Lite: Fully tempered float glass.
 - 6. Low-E Coating: Sputtered on second surface.
 - 7. Winter Nighttime U-Factor: 0.29 maximum.
 - 8. Visible Light Transmittance: 70 percent minimum.
 - 9. Solar Heat Gain Coefficient: 0.39 maximum.

END OF SECTION 08 80 00

SECTION 08 84 00 – PLASTIC GLAZING

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 SECTION INCLUDES

- A. Polycarbonate plastic glazing
- B. Enhanced UV-resistant polycarbonate plastic glazing.
- C. Laminated polycarbonate plastic glazing.

1.3 RELATED SECTIONS

- A. Section 07 92 00 – Joint Sealants
- B. Section 09 24 00 – Cement Plaster

1.4 REFERENCES

- A. ANSI Z 97.1 - American National Standard for Glazing Materials Used in Buildings -- Safety Performance Specifications and Methods of Test.
- B. ASTM D 256 - Standard Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.
- C. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.
- D. ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- E. ASTM D 1929 - Standard Test Method for Ignition Properties of Plastics.
- F. ASTM D 635 – Standard Test Method for Rate of Building and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- G. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials
- H. CAN/ULC 102.2 – Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

1.5 ACTION SUBMITTALS

- A. General: Submit the following in accordance with conditions of contract and Division 1 specification section 01 33 00 "Submittal Procedures".
- B. Product Data: Submit manufacturer's product data; including product description, fabrication information, and compliance with specified performance requirements.
- C. Submit product test reports from a qualified independent 3rd party testing agency indication each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed test reports will be acceptable if for current manufacturer and indicative of products used on this project.
 - 1. Test reports required are:
 - 2. Rate of Burning (ASTM D 635)
 - 3. Self-Ignition Temperature (ASTM D 1929)
 - 4. Flame Spread and Smoke Developed (ASTM E 84)
 - 5. Impact Strength (ASTM D 3763)
 - 6. Safety Glazing and Impact Strength (ANSI Z97.1-2004)
- D. Samples for Initial Selection:
 - 1. Submit minimum 2-inch by 2-inch samples. Indicate full color.
- E. Maintenance Data: Submit manufacturer's care and maintenance data, including care, repair and cleaning instructions. Include in Project closeout documents.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications
 - 1. Materials and systems shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least five (5) consecutive years and which can show evidence of those materials being satisfactory used on at least six (6) projects of similar size, scope and location.
 - 2. Manufacturer must have documented training and qualification program for fabrication and installation of plastic fabrications.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver Plastic Fabrications, systems and specified items in manufacturer's standard protective masking.
- B. Store materials in a flat orientation in a dry place that is not exposed to exterior elements.
- C. Handle materials to prevent damage to finished surfaces.
- D. Before installing Plastic Fabrications, permit them to reach room temperature.
- E. Do not deliver Plastic Fabrications, systems, components and accessories to Project site until areas are ready for installation.

1.8 WARRANTY

- A. Manufacturer's Special Warranty on Plastic Fabrications: Manufacturer's standard form agreeing to repair or replace units that fail in material or workmanship within the specified warranty period.
- B. Warranty Period: 5 years from ship date.
- C. The warranty shall not deprive the owner of other rights or remedies the Owner may have under provisions of the Contract Documents and is in addition to and runs concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. 3form, Inc. Salt Lake City, Utah, USA / telephone 801-649-2500
 - 2. Or equal in accordance with general requirements 01

2.2 MATERIALS

- A. Koda XT produced from polycarbonate sheet
 - 1. Engineered polycarbonate resin
 - 2. Sheet Size: Maximum 4'x10'
 - 3. Thickness: Minimum ¼"
 - 4. Basis of Design Product: The design of Plastic Fabrications is based on Koda XT as provided by 3form, Inc.
- B. Sheet Minimum Performance Attributes:
 - 1. Rate of Burning (ASTM D 635). Material must attain CC1Rating for a nominal thickness of 1.5 mm (0.060 in.) and greater.
 - 2. Self-Ignition Temperature (ASTM D 1929). Material must have a Self-Ignition Temperature greater than 650°F.
 - 3. Flame Spread and Smoke developed testing (ASTM E 84). Material must be able to meet a level of Class B (Flame spread less than 75 and smoke less than 450) at thickness of ½".
 - 4. Impact Strength. Minimum impact strength test as measured by ASTM D 3763 of 20 ft. lbs. (for durability, shipping, installation, and use).
 - 5. Safety Glazing. Material must attain a Class A impact rating in accordance with ANSI Z97.1-2004.
- C. Interlayer Materials:
 - 1. C3 Color: Play with 50,000 options in the core color palette. Combine colors up to three layers deep to control the hue, intensity and translucency, creating an exciting range of exact color specifications.
 - 2. HighRes: Translucent high-resolution imagery.

2.3 FABRICATION

- A. General: Fabricate Plastic Fabrications to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes, profiles and other characteristics are indicated on the drawings.
- B. Comply with manufacturer's written recommendations for fabrication.
- C. Machining: Acceptable means of machining are listed below. Ensure that material is not chipped or warped by machining operations.
 - 1. Sawing: Select equipment and blades suitable for type of cut required.
 - 2. Drilling: Drills specifically designed for use with plastic products.
 - 3. Milling: Climb cut where possible.
 - 4. Routing
 - 5. Tapping
- D. Forming: Form products to shapes indicated using the appropriate method listed below. Comply with manufacturer's written instructions.
 - 1. Cold Bending
 - 2. Hot Bending
- E. Laminating: Laminate to substrates indicated using adhesives and techniques recommended by manufacturer.

2.4 ACCESSORIES

- A. Gaskets shall be as per manufacturer's standards to meet performance criteria.
- B. Fasteners shall be per manufacturer's standards to meet performance requirements.

2.5 MISCELLANEOUS MATERIALS

- A. General: Provide products of material, size, and shape required for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaner: Type recommended by manufacturer.
- C. Fasteners: Use screws designed specifically for plastics. Retain this article for large projects or critical coatings where additional control is needed. Delete if tests are not required.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where installation of Plastic Fabrications will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for installation and comply with requirements specified.

PLASTIC GLAZING

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3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions for the installation of Plastic Fabrications.
- B. Manufacturer's shop to fabricate items to the greatest degree possible.
- C. Utilize all fasteners recommended by manufacturer for type of installation indicated. Material that is chipped, warped, hazed or discolored as a result of installation or fabrication methods will be rejected.
- D. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.

3.3 CLEANING AND PROTECTION

- A. Protect surfaces from damage until date of substantial completion. Repair work or replace damaged work, which cannot be repaired to Architect's satisfaction.

END OF SECTION 08 84 00

SECTION 08 91 19 - FIXED LOUVERS

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. Fixed extruded-aluminum louvers.
- B. Related Requirements:
 - 1. Section 08 11 13 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.

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. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades is horizontal).
- C. Vertical Louver: Louver with vertical blades (i.e., the axis of the blades is vertical).
- D. 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.
- E. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing according to AMCA 500-L.
- F. Windborne-Debris-Impact-Resistant Louver: Louver that provides specified windborne-debris-impact resistance, as determined by testing according to AMCA 540.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- B. Sample Warranties: For manufacturer's special warranties.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers shall withstand 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 normal to the face of the building.
 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
- B. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

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

2.3 FIXED EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Drainable-Blade Louver:

1. Louver Depth: 4 inches.
2. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
3. Mullion Type: Exposed.
4. Louver Performance Ratings:
 - a. Free Area: Not less than 8.0 sq. ft. for 48-inch-wide by 48-inch-high louver.
 - b. Point of Beginning Water Penetration: Not less than 850 fpm.
 - c. Air Performance: Not more than 0.2-inch wg static pressure drop at 1000-fpm free-area exhaust or intake velocity.
5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening, unless insect screening is indicated

- B. Secure screen frames to louver frames with machine screws with heads finished to match louver, 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 type 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.

- D. Louver Screening for Aluminum Louvers:

1. Insect Screening: Stainless steel, 18-by-18 (1.4-by-1.4-mm) mesh, 0.009-inch (0.23-mm) wire.

2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.

- B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

- C. Fasteners: Use types and sizes to suit unit installation conditions.

FIXED LOUVERS

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1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 3. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Post installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing according to ASTM E488/E488M conducted by a qualified testing agency.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. 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.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.
1. Semi recessed Mullions: Where indicated, provide mullions partly recessed behind louver blades, so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
 2. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
- F. 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, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.7 ALUMINUM FINISHES

- A. Finish louvers after assembly.

- B. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and 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.
 - 1. Color and Gloss: As selected by Architect – to match adjacent paint finish.

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 of the Work.
- B. 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 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. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers 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 08 91 19

SECTION 09 05 61.13 - MOISTURE VAPOR EMISSION 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. Fluid-applied, resin-based, membrane-forming systems that control the moisture-vapor-emission rate of high-moisture, interior concrete to prepare it for floor covering installation.
 - a. Install at all ground level concrete to receive new flooring finish.

1.3 DEFINITIONS

- A. MVE: Moisture vapor emission.
- B. MVER: Moisture vapor emission rate.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each MVE-control system, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Preinstallation testing reports.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Employs factory-trained personnel who are available for consultation and Project-site inspection.

- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating directions for storage and mixing with other components.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.
 - 1. Store system components in a temperature-controlled environment and protected from weather and at ambient temperature of not less than 65 deg F and not more than 85 deg F at least 48 hours before use.
 - 2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than 65 deg F or more than 85 deg F and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
 - 3. Install MVE-control systems where concrete surface temperatures will remain a minimum of 5 deg F higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:
 - 1. MVER: Maximum 25 lb of water/1000 sq. ft. when tested according to ASTM F1869.
 - 2. Relative Humidity: Maximum 100 percent when tested according to ASTM F2170 using in situ probes.
- B. Water-Vapor Transmission: Through MVE-control system, maximum 0.06 perm when tested according to ASTM E96/E96M.
- C. Tensile Bond Strength: For MVE-control system, greater than 200 psi with failure in the concrete according to ASTM D7234.
- D. VOC limits < 100g/l.

2.2 MVE-CONTROL SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Floor Seal Technology, Inc.
 - 2. KOSTER American Corporation.
 - 3. Madewell Products Corporation.
- B. MVE-Control System: ASTM F3010-qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.
 - 1. Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
 - 2. Cementitious Underlayment Primer: If required for subsequent installation of cementitious underlayment products, provide MVE-control system manufacturer's primer to ensure adhesion of products to MVE-control system.

2.3 ACCESSORIES

- A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 3000-psi compressive strength after 28 days when tested according to ASTM C109/C109M.
- B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.
- C. Cementitious Underlayment: If required to maintain manufacturer's warranty, provide MVE-control system manufacturer's recommended hydraulic cement-based underlayment.
 - 1. Basis-of-Design: K-15 by Ardex Engineered Cements, Inc., or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of system indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Preinstallation Testing:

1. Testing Agency: Engage a qualified testing agency to perform tests.
 - a. For testing, use systems of Vaprecision Professional Emission Testing Systems, or Sealflex Industries, Inc., or equal.
 2. Alkalinity Testing: Perform pH testing according to ASTM F710. Install MVE-control system in areas where pH readings are less than 7.0 and in areas where pH readings are greater than 8.5.
 3. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Install MVE-control system in locations where concrete substrate MVER exceeds 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Internal Relative Humidity Test: Using in situ probes, ASTM F2170. Install MVE-control system in locations where concrete substrates exhibit relative humidity level greater than 75 percent.
 4. Tensile-Bond-Strength Testing: For typical locations indicated to receive installation of MVE-control system, install minimum 100-sq. ft. area of MVE-control system to prepared concrete substrate and test according to ASTM D7234.
 - a. Proceed with installation only where tensile bond strength is greater than 200 psi with failure in the concrete.
- B. Concrete Substrates: Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.
1. Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
 2. Provide concrete surface profile complying with ICRI 310.2R CSP 3 by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 3. After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.
 4. Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
 5. Fill surface depressions and irregularities with patching and leveling material.
 6. Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
 7. Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
 8. Before installing MVE-control systems, broom sweep and vacuum prepared concrete.
- C. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

3.3 INSTALLATION

- A. Install MVE-control system according to ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.

1. Install primers as required to comply with manufacturer's written instructions.
- B. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.
- C. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.
- D. Cure MVE-control system components according to manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.
- E. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.
- F. Install cementitious underlayment over cured membrane if required to maintain manufacturer's warranty and in thickness required to maintain the warranty.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform installation inspections.
- B. Installation Inspections: Inspect substrate preparation and installation of system components to ensure compliance with manufacturer's written instructions and to ensure that a complete MVE-control system is installed without deficiencies.
 1. Verify that surface preparation meets requirements.
 2. Verify that component coats and complete MVE-control-system film thicknesses comply with manufacturer's written instructions.
 3. Verify that MVE-control-system components and installation areas that evidence deficiencies are repaired according to manufacturer's written instructions.
- C. MVE-control system will be considered defective if it does not pass inspections.

3.5 PROTECTION

- A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.
- B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

END OF SECTION 09 05 61.13

SECTION 09 24 00 - CEMENT PLASTERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior plasterwork (stucco).

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.
- C. Samples for Verification: For each type of factory-prepared finish coat and for each color and texture specified, 12 by 12 inches, and prepared on rigid backing.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.5 FIELD CONDITIONS

- A. Comply with ASTM C926 requirements.
- B. Exterior Plasterwork:
 - 1. Substrate Temperature: Do not apply stucco system materials to substrates whose temperature are below 40°F or contain frost or ice.
 - 2. Inclement Weather: Do not apply stucco system materials during inclement weather, unless appropriate protection is employed.
 - 3. Sunlight Exposure: Avoid, when possible, installation of the stucco system materials in direct sunlight. Application of finishes in direct sunlight in hot weather may adversely affect aesthetics.
 - 4. Do not apply stucco base coats or finishes if ambient temperature falls below 40°F (4°C) within 24 hours of application. Protect stucco materials from uneven and excessive evaporation during dry weather and strong blasts of dry air.

5. Prior to installation, the substrate shall be inspected for surface contamination, or other conditions that may adversely affect the performance of the stucco system materials and shall be free of residual moisture.
- C. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Stucco application shall be to vertical substrates or to substrates sloped for positive drainage according to ASTM C926. Substrates sloped for drainage shall have additional protection from weather exposure that might be harmful to material performance.
- B. Fire-Resistance Ratings: Where indicated, provide cement plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E119 by a qualified testing agency.
- C. Substrate Conditions:
 1. Substrates shall be sound, dry and free of dust, dirt, laitance, efflorescence and other harmful contaminants.
 2. Substrate Dimensional Tolerances: Flat with 1/4 in (6.4 mm) within any 10 ft (3 m) radius.
 3. Maximum deflection of substrate system under positive or negative design loads shall not exceed L/360 of span.
- D. Expansion and Control Joints: Continuous expansion and control joints shall be installed at locations in accordance with ASTM C1063 and ASTM C926.
 1. Substrate movement, and expansion and contraction of stucco and adjacent materials shall be considered in design of expansion joints, with proper consideration given to sealant properties, installation conditions, temperature range, coefficients of expansion of materials, joint width to depth ratios, and other material factors. Minimum width of expansion joints shall be as specified by the designer or shown on the project drawings.
 2. In accordance with ASTM C1063, expansion or control joints shall be installed in walls not more than 144 ft² (13.4 m²) in area, and not more than 100 ft² (9.3 m²) in area for all non-vertical applications. The distance between joints shall not exceed 18 ft (5.5 m) in either direction or a length-to-width ratio of 2-1/2 to 1.

2.2 METAL LATH

- A. Expanded-Metal Lath: ASTM C847, cold-rolled carbon-steel sheet with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.
 1. Diamond-Mesh Lath: Flat and Self-furring, 3.4 lb./sq. yd.
 2. Flat-Rib Lath: Rib depth of not more than 1/8-inch, 3.4 lb./sq. yd.
- B. Paper Backing: FS UU-B-790a, Type I, Grade D, Style 2 vapor-permeable paper.
 1. Provide paper-backed lath at exterior locations and at locations indicated on Drawings.

CEMENT PLASTERING

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2.3 ACCESSORIES

- A. General: Comply with ASTM C1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
- B. Metal Accessories:
 - 1. Foundation Weep Screed: Fabricated from hot-dip galvanized-steel sheet, ASTM A653/A653M, G60 zinc coating.
 - 2. Cornerite: Fabricated from metal lath with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.
 - 3. External- (Outside-) Corner Reinforcement: Fabricated from metal lath with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.
 - 4. Cornerbeads: Fabricated from zinc or zinc-coated (galvanized) steel.
 - a. Smallnose cornerbead with expanded flanges; use unless otherwise indicated.
 - b. Smallnose cornerbead with perforated flanges; use on curved corners.
 - c. Smallnose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
 - 5. Casing Beads: Fabricated from zinc or zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
 - 6. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
 - 7. Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
 - 8. Extruded Aluminum Parapet Screed: Mill finish extruded aluminum screed. Basis-of-Design as indicated on drawings.
- C. Soffit vents:
 - 1. Provide continuous soffit vents designed to be used with cement plaster finish.
 - 2. Basis-of-Design:
 - a. Bugstop Soffit Vent by Stockton Products (Product code SBS).
 - b. Emberstop Soffit Vent by Stockton Products (Product code SES). At all locations except where bugstop is indicated.
 - 3. Materials: Galvanized steel with aluminum screen.
 - 4. Size: 4". Height per cement plaster thickness.

2.4 MISCELLANEOUS MATERIALS

- A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2-inch-long, free of contaminants, manufactured for use in cement plaster.
- C. Bonding Compound: ASTM C932.

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- D. Fasteners for Attaching Metal Lath to Substrates: #10 Pan Wafer screws at 7" O.C. maximum; ASTM C1063.
- E. Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter unless otherwise indicated.
- F. Seals, Sealants and Bond Breakers: Sealants shall conform to ASTM C 920, Grade NS, Class 25, Use NT. Backer rod shall be closed-cell polyethylene foam.

2.5 PLASTER MATERIALS

- A. Factory Blended Portland Cement Plaster Basecoats and Finish: Products as fabricated by California Stucco, La Habra, Shamrock Stucco, Merlex, Omega Stucco, Inc., Expo Stucco, Spec Mix, Quikrete or other manufacturer member of the Stucco Manufacturer's Association (SMA).
 - 1. Material Standards:
 - a. Portland Cement: ASTM C150.
 - b. Hydrated Lime: ASTM C206.
 - c. Sand: ASTM C897.
 - d. Fibers: ASTM C1116.
 - 2. Three Coat Systems:
 - a. Scratch and Brown Coats: Factory blended fiber reinforced plaster and sand mix conforming to ASTM C926, and requiring only the addition of water. Total thickness of coats: 7/8 inch.
 - b. Finish Coat: Factory blended cementitious stucco color coat, integrally colored with fade-resistant pigments. Coat thickness 1/8 inch.
 - c. Color and Texture: As indicated on drawings, or if not indicated, as selected by the architect from manufacturer's full range.
- B. Water: Clean, cool, potable water.

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 the Work.
- B. Substrate Examination: Examine prior to stucco base installation as follows:
 - 1. Substrate shall be of a type approved by stucco system manufacturer and the building code having jurisdiction. Plywood and OSB substrates shall be gapped 1/8 in (3.2 mm) at all edges.
 - 2. Substrate shall be examined for soundness, and other harmful conditions.
 - 3. Substrate shall be free of dust, dirt, laitance, efflorescence, and other harmful contaminants.

4. Substrate construction in accordance with substrate material manufacturer's specifications and applicable building codes.

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

3.2 PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
- B. Prepare smooth, solid substrates for plaster according to ASTM C926.

3.3 INSTALLATION, GENERAL

- A. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.

3.4 INSTALLING METAL LATH

- A. Metal Lath: Install according to ASTM C1063.
 1. Partition Framing and Vertical Furring: Install flat-diamond-mesh lath.
 2. Flat-Ceiling and Horizontal Framing: Install flat-diamond-mesh or flat-rib lath.
 3. On Solid Surfaces, Not Otherwise Furred: Install self-furring, diamond-mesh lath.

3.5 INSTALLING ACCESSORIES

- A. Install according to ASTM C1063 and at locations indicated on Drawings.
- B. Reinforcement for External (Outside) Corners:
 1. Install cornerbead at exterior locations.
 2. Install cornerbead at interior locations.
- C. Control Joints: Locate as approved by Architect for visual effect and as follows:
 1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
 - a. Vertical Surfaces: 144 sq. ft.
 - b. Horizontal and Other Nonvertical Surfaces: 100 sq. ft.
 2. At distances between control joints of not greater than 18 feet o.c.
 3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
 4. Where control joints occur in surface of construction directly behind plaster.
 5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.6 PLASTER APPLICATION

- A. Mix proprietary products in accordance with manufacturer's instructions, including the applicable stucco system product data sheets and application guidelines.
- B. General: Comply with ASTM C926 and manufacturer's application guide.
 - 1. Do not deviate more than plus or minus 1/4 inch in 10 feet from a true plane in finished plaster surfaces when measured by a 10-foot straightedge placed on surface.
 - 2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
 - 3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.
- C. Walls; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork with 3/4-inch total thickness, as follows:
 - 1. Portland cement mixes.
- D. Ceilings; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork and having 1/2-inch total thickness, as follows:
 - 1. Portland cement mixes.
- E. Plaster Finish Coats: As selected by the architect from manufacturer's full range.
- F. Concealed Exterior Plasterwork: Where plaster application is used as a base for adhered finishes, omit finish coat.

3.7 PLASTER REPAIRS

- A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.8 CLEANING AND PROTECTION

- A. Remove temporary protection and enclosure of other work after plastering is complete. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 09 24 00

SECTION 09 29 00 - GYPSUM BOARD

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 gypsum board.
2. Tile backing panels.
3. Texture finishes.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For the following products:
 1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.
 2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet, or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Georgia-Pacific Gypsum LLC.
 2. National Gypsum Company.
 3. USG Corporation.
 4. Approved equal.
- B. Gypsum Wallboard: ASTM C1396/C1396M.
 1. Thickness: As indicated.
 2. Long Edges: Tapered.
- C. Gypsum Board, Type X: ASTM C1396/C1396M.
 1. Thickness: 5/8 inch.
 2. Long Edges: Tapered.
- D. Abuse-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.
 1. Core: 5/8-inch, Type X.
 2. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
 3. Indentation: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
 4. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
 5. Long Edges: Tapered.
 6. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

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- E. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
 - 1. Core: As indicated.
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
 - 1. Thickness: As indicated.
 - 2. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (control) joint.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
 - 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy 6063-T5.
 - 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.

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3. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
- D. Joint Compound for Tile Backing Panels:
 1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Thermal Insulation: As specified in Section 07 21 00 "Thermal Insulation."
- F. Vapor Retarder: As specified in Section 07 26 00 "Vapor Retarders."

2.8 TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.
- B. Non-Aggregate Finish: Premixed, vinyl texture finish for spray application.

- a. Texture: Orange peel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install 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.
- D. 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.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support 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 structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

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- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control 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 C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: As indicated on Drawings.
 - 2. Type X: As indicated on Drawings and where required for fire-resistance-rated assembly.
 - 3. Abuse-Resistant Type: High traffic interior corridors and as indicated on Drawings.
 - 4. Mold-Resistant Type: Wet areas not scheduled to receive wall tiles.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) 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 panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 - 3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 - 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 APPLYING TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 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.
- B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners unless otherwise indicated.
 2. LC-Bead: Use at exposed panel edges.
- D. Aluminum Trim: Install in locations indicated on Drawings.

3.6 FINISHING GYPSUM BOARD

- 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 and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.

GYPSUM BOARD

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2. Level 2: Panels that are substrate for tile.
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

- E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.
- F. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 APPLYING TEXTURE FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture free of starved spots or other evidence of thin application or of application patterns.
- C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written instructions.

3.8 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet, or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

SECTION 09 30 13 - CERAMIC 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 mosaic tile.
 - 2. Glazed wall and floor tile.
 - 3. Stone thresholds.
 - 4. Waterproof membrane for thin-set applications.
 - 5. Crack isolation membrane.
 - 6. Metal edge strips.

- B. Related Requirements:

- 1. Section 07 92 00 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 2. Section 09 29 00 "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 its "Specifications for Installation of Ceramic Tile."
- C. Face Size: Actual tile size, excluding spacer lugs.
- D. Module Size: Actual tile size plus joint width indicated.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site Insert location.
 - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- 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 Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Full-size units of each type of trim and accessory for each color and finish required.
 - 3. Stone thresholds in 6-inch lengths.
 - 4. Metal edge strips in 6-inch lengths.
 - 5. Grout in color(s) selected by the architect in minimum 3-inch lengths.

1.6 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.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.

1.8 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.

1.9 FIELD 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.

1.10 PERFORMANCE REQUIREMENTS

- A. Comply with California Building Code, Section 11B-302.1.
 - 1. Tiles shall be stable, firm and slip resistant.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

2.2 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 TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. 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.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
 - 1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 TILE PRODUCTS

- A. Ceramic Tile Type [TF-01]: Ceramic Floor Tile and coved base.

CERAMIC TILING

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1. Basis-of-Design: As indicated on the drawings.
2. Composition: Porcelain.
3. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
4. Module Size: As indicated on the drawings.
5. Thickness: 7/16 inch.
6. Face: Plain with cushion edges.
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Tile Color and Pattern: As indicated on the drawings.
9. Grout Color: As indicated on the drawings.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as indicated on drawings.

B. Ceramic Tile Type [TW-1 thru TW-4]: Porcelain wall tile.

1. Basis-of-Design: As indicated on the drawings.
2. Type: through body porcelain.
3. Module Size: As indicated on the drawings.
4. Tile Color and Pattern: As indicated on the drawings.
5. Grout Color: As selected by Architect from manufacturer's full range.
6. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as indicated on drawings.

2.4 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 C503/C503M, with a minimum abrasion resistance of 10 according to ASTM C1353 or ASTM C241/C241M and with honed finish.
1. Description: As indicated on the drawings.

2.5 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

2.6 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

2.7 SETTING MATERIALS

- A. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
 - 1. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
- B. Medium-Bed, Modified Dry-Set Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of 5/8 inch.

2.8 GROUT MATERIALS

- A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. High-Performance Tile Grout: ANSI A118.7.
 - 1. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
 - 2. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.
- C. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.
 - 1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

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. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D4397, 4.0 mils thick.
- C. Metal Edge Strips: Cove and edge profiles as indicated on drawings, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for tiling applications; anodized aluminum exposed-edge material.
- 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.

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 the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with 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 waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not, factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION OF CERAMIC TILE

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Exterior tile floors.
 - b. Tile floors in wet areas.
 - c. Tile floors consisting of tiles 8 by 8 inches or larger.
 - d. Tile floors consisting 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. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 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.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Ceramic Mosaic Tile: 1/16 inch.
 - 2. Quarry Tile: 1/4 inch.
 - 3. Glazed Wall Tile: 1/16 inch.
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

- I. 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.
- J. 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 modified dry-set mortar (thin set).
 - 2. Do not extend waterproof membrane or crack isolation membrane under thresholds set in modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on waterproof membrane or crack isolation membrane with elastomeric sealant.
- K. Metal Edge Strips: Install at any location where tile edges end not at wall joints or where tile has exposed edges.

3.4 INSTALLATION OF WATERPROOF MEMBRANE

- A. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- B. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.5 INSTALLATION OF CRACK ISOLATION MEMBRANE

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
- B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.6 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove 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.

3.7 PROTECTION

- A. 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.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Ceramic Tile Installation: TCNA F125-Full; thin set mortar on crack isolation membrane.
 - a. Ceramic Tile Type: See finish schedule in drawings.
 - b. Thin set Mortar: Medium-bed, modified dry-set mortar.
 - c. Grout: Water-cleanable epoxy grout.
- B. Interior Wall Installations, Wood Studs or Furring:
 - 1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thin set mortar on cementitious backer units or fiber-cement backer board over vapor-retarder membrane.
 - a. Ceramic Tile Type: See finish schedule in drawings.
 - b. Thin set Mortar: Modified dry-set mortar.
 - c. Grout: High-performance unsanded grout, unless indicated otherwise.

END OF SECTION 09 30 13

SECTION 09 51 13 - 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

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. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size panels equal to 5 percent of quantity installed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site 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.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products of the following manufactures form the basis for design and quality intended.
 - 1. Armstrong World Industries, Lancaster, PA
 - 2. USG Interiors, Chicago, IL.
 - 3. Or approved equal.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 - 1. California Building Code (CBC) requirements, Seismic Design Category D, including the following:
 - a. ASCE 7, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," including Section 13, "Seismic Design Requirements for Nonstructural Components."
 - 1) Comply with the additional requirements of CBC Section 1617A.1.21.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A according to ASTM E 1264.
 - 2. Smoke-Developed Index: 450 or less.
- C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL or from the listings of another qualified testing agency.

- D. Urea Formaldehyde: Acoustical panel products shall contain no urea formaldehyde. Low-content products (less than 13.5 ppb urea formaldehyde) shall be evaluated on an individual case basis.
- E. Low-Emitting Material: Provide acoustical ceiling panels that are third-party certified to have been tested and passed the following indoor air quality standard:
 - 1. Comply with the volatile organic compound emissions requirements of California Section 01350 as described in CA Department of Health Services Standard Practice CA/DHS/EHLB/R-174.

2.3 ACOUSTICAL PANELS

- A. Manufacturers:
 - 1. Armstrong World Industries, Inc; Products as indicated on drawings: www.armstrong.com.
 - a. Basis of Design Product other mfgs will be considered if equal products are available.
 - 2. Or approved equal.
 - 3. Provide components of each system from one manufacturer.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Product General Requirements
 - 1. Repair cut units to match uncut units including tegular edges.
- D. Refer to Finish Schedule for ACP ceiling tile information.

2.4 METAL SUSPENSION SYSTEM

- A. Basis-of-Design: Heavy-Duty Armstrong Prelude XL Grid System (ICC-ES ESR-1308).
- B. Suspension Systems - General: ASTM C 635; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- C. Color: white.
- D. Edge Trim and Molding: Provide reveal edge "shadow mold" trim where ceiling meets vertical surfaces.; avoid joints in runs under 4'-0" long; miter corners where moldings intersect.

2.5 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Perimeter Moldings: Same material and finish as grid.

- C. Acoustical Insulation: Specified in Section 09 29 00 (Sound Attenuating Blankets).
 - 1. Thickness: 2 inches.
 - 2. Size: To fit acoustical suspension system.
 - 3. Location: Above all offices and conference rooms where walls / insulation do not extend full height to underside of deck.
- D. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- E. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
 - 3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
 - 4. Size: Wire diameter enough for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.
- 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, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.
- G. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.
- H. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- I. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. 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 comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - 1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
- B. 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 seismic design requirements.
 - 1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

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. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. 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 unless otherwise indicated and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M, seismic design requirements, manufacturer's written instructions and the following:
 - 1. DSA IR 25-2.13.
- B. 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.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. 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 precise fit.

1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners' level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
 1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and post installed anchors used to attach hangers to concrete and will test them for 200 lbf200 lbf (890 N) of tension; it will also select one of every two post installed anchors used to attach bracing wires to concrete and will test them for 440 lbf440 lbf (1957 N) of tension.
 2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 passes consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 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.

- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

SECTION 09 53 00 – WOOD BAFFLE CEILING AND WALL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes wood baffle system for interior ceilings and walls.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices.
- C. Related Sections:
 - 1. Sections 09 51 13 – Acoustical Panel Ceilings
 - 2. Division 23 – Heating, Ventilating and Air Conditioning
 - 3. Division 26 – Electrical

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. E 84 – “Standard Test Method for Surface Burning Characteristics of Building Materials”
 - 2. E 488 – “Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements”
 - 3. B 209 – “Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate”
 - 4. C 423 – “Sound Absorption and Sound Absorption Coefficients by Reverberation Room Method”
 - 5. E 580 – “Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint”
 - 6. C 635 – “Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings”
 - 7. C 636 – “Recommended Practice for Installation of Metal Ceiling Suspensions Systems for Acoustical and Lay-in Panels”
 - 8. A 641 – “Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire”
 - 9. A 653 – “Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip process.”
 - 10. E 1264 – Classification for Acoustical Ceiling Products”
 - 11. E 1477 – Standard Test Method for Luminous Reflectance factor of Acoustical Materials by use of Integrating-Sphere Reflectometers”
 - 12. D 1002 – Practice for Adhesion Resistance
- B. California Building Code, current edition requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.
- C. Shop Drawings: Submit shop drawings showing all areas involved, attachment conditions and perimeter circumstances.

1.5 QUALITY ASSURANCE

- A. Design Criteria: Manufacture of Wood Baffles shall be installed true and plumb to within manufacturing tolerance of 1/8" within 8' of length.
- B. Product Construction: Wood shall be kiln dried to 10%. Cracking, checking and warpage of members will not be acceptable.
- C. Fire-Test-Response Characteristics: Class 1, or A flame spread rating, when tested according to ASTM E-84.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size panels equal to 5 percent of quantity installed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site 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 wood baffles, permit them to reach room temperature and a stabilized moisture content.
- C. Material must be stored and installed only in secured ambient environment (humidity min. 25% - max. 55%, temperature not to exceed 86 degrees).
- D. Windows, doors and all wet-work must be completed before unpacking and installation. Handle carefully to avoid damage.

1.8 WARRANTY

- A. The contractor shall warranty for one year all work from final acceptance of completed work. Changes in finish or dimensions due to ultra violet light, excessive temperature or humidity conditions and/or abuse of any kind shall void any warranties.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 - 1. California Building Code (CBC) requirements, Seismic Design Category D, including the following:
 - a. ASCE 7, "Minimum Design Loads for Buildings and Other Structures," including Section 13, "Seismic Design Requirements for Nonstructural Components."
 - b. Comply with the additional requirements of CBC Section 1617A.1.21.

2.2 MANUFACTURERS

- A. Products of the following manufactures form the basis for design and quality intended.
 - 1. Architectural Components Group a division of Armstrong World Industries, Lancaster, PA
 - 2. Or approved equal.

2.3 PRODUCT TYPE

- A. Product Configuration: Wood Baffle Series 1, product: WB1-2400-E
 - 1. Nomenclature for WB1-2400-E:
 - 2. WB1 = Wood Baffle Series 1
 - 3. 2 = 2 members per foot
 - 4. 400 = 4" deep baffles
 - 5. E = 1" thick
- B. Baffle panels width shall be 1' wide as required for installation.
- C. Panel Length:
 - 1. Veneered members shall be provided in fixed panel lengths of 8' or 10' lengths.
- D. Specie: System shall consist of:
 - 1. Manufacture's standard veneer
 - 2. Veneered blades shall have matching edge banding on one long edge.
- E. Finish: refer to finish schedule for custom match.
- F. Fire Rating: Baffles shall achieve a Class I(A) fire rating.
- G. Wood Baffle System: Factory assembled with black notched backers at 12" on center. Wood Baffle shall have optional dowels.
- H. Attachment System: Baffle System shall be suspended according to manufacturers suggested method of suspension as per the design details provided in the plans.

2.4 METAL SUSPENSION SYSTEM

- A. Basis-of-Design: Heavy-Duty Armstrong Prelude XL Grid System (ICC-ES ESR-1308).
- B. Suspension Systems - General: ASTM C 635; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- C. Color: white.
- D. Edge Trim and Molding: Provide reveal edge "shadow mold" trim where ceiling meets vertical surfaces.; avoid joints in runs under 4'-0" long; miter corners where moldings intersect.

2.5 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Perimeter Moldings: Same material and finish as grid.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
 - 3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
 - 4. Size: Wire diameter enough for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.
- E. 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, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.
- F. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.
- G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

WOOD BAFFLE CEILING AND WALL SYSTEM

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which wood baffle ceilings and walls attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling or wall installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of wood baffles.
- B. Examine wood baffles before installation. Reject baffles that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling and wall area and establish layout of baffles to balance widths at opposite edges of each ceiling and wall.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install wood baffle ceilings according to ASTM C 636/C 636M, seismic design requirements, manufacturer's written instructions and the following:
 - 1. DSA IR 25-2.13.
- B. Wood Baffle System shall be handled and installed with care in order to prevent surface and structure damage. Field cutting shall be kept to a minimum and performed as recommended by manufacturer.
- C. The Baffle ceiling system shall be suspended by HD T-grid with main runners on 2' centers and cross T's every 4'.
- D. 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.
- 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 wood baffles with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
 - 1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners' level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 - 1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
 - 1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and post installed anchors used to attach hangers to concrete and will test them for 200 lbf 200 lbf (890 N) of tension; it will also select one of every two post installed anchors used to attach bracing wires to concrete and will test them for 440 lbf 440 lbf (1957 N) of tension.
 - 2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 passes consecutively and then will resume initial testing frequency.
- D. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 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.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 53 00

WOOD BAFFLE CEILING AND WALL SYSTEM

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SECTION 09 54 46 – ACOUSTICAL PANEL CEILING BLADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Non-Woven layered and formed Polyester felt fiber ceiling panels
 - 2. Wire hangers, fasteners, main runners, cross tees, wall angle moldings and accessories.
- B. Related Requirements:
 - 1. Section 09 51 13 - Acoustical Ceiling Suspension Assembly
 - 2. Section 09 29 00 - Gypsum Board
 - 3. Divisions 23 - HVAC
 - 4. Division 26 Sections - Electrical Work

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
 - 2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. ASTM E580 Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint.
 - 4. ASTM C423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 5. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests
 - 6. ASHRAE Standard 62.1-2004 Ventilation for Acceptable Indoor Air Quality
 - 7. California Department of Public Health CDPH/EHLB Emission Standard Method Version 1.2 2017
 - 8. California Green Building Standards Code Cal Green Title 24
 - 9. NFPA 70 National Electrical Code
 - 10. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
 - 11. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
 - 12. Underwriters Laboratories Green Guard

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Provide layout including panel type and components used in the assembly of the ceiling. Show locations of items that are to be coordinated with the ceiling.
- B. Samples: Minimum 6 inch x 6 inch sample of the colors selected in the ceiling design, include manufacturer sample of suspension components.
- C. Product Data: Submit manufacturer's technical data for each type of ceiling unit and suspension system required.
- D. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide ceiling panel units and suspension components by a single manufacturer.
- B. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.
- C. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with Class A products.
- D. Flame Spread: 25 or less
- E. Smoke Developed: 450 or less
- F. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- C. White gloves recommended for handling to avoid marring, especially on light color panels.

1.7 WARRANTY

- A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period.
- B. Warranty Period:

1. Acoustical panels and Suspension: One (1) year from date of substantial completion
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.8 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
 1. Ceiling Units: Furnish quality of full-size units equal to 2.0 percent of amount installed.
 2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 1.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design FELTWORKS Blades:
 1. Armstrong World Industries, Inc.
 2. Or approved equal.
- B. Suspension Systems:
 1. Armstrong World Industries, Inc.
 2. Or approved equal.

2.2 CEILING UNITS

- A. Ceiling Panel:
 1. Surface Texture: Soft
 2. Composition: Non-woven layered and formed Polyester felt (PET) fiber
 3. Color: Whisper
 4. Edge Profile: Square
 5. Light Reflectance (LR) Cotton Panel: ASTM E 1477; 0.80
 6. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
 7. Green Guard Gold Certified
 8. Sizes:
 - a. 6533KPV0001_ _ _ 96" Peaks & Valleys Blades Kit Includes 12 unique shapes – 2 of each – 24 pcs per kit Varies x 96" x 3/8"
 - b. 6533KPV0002_ _ _ 48" Peaks & Valleys Blades Kit Includes 6 unique shapes – 4 of each – 24 pcs per kit Varies x 48" x 3/8"
 9. Acoustical Performance is tested per ASTM C423 and mounted in accordance with ASTM E795. NRC of 0.85 based on E-400 mounting*
 10. Flame Spread: Class A
 11. Dimensional Stability: HumiGuard Plus.

2.3 SUSPENSION SYSTEMS

- A. Armstrong Aluminum Suspension System:
 - 1. Acceptable Product: Listed Below as manufactured by Armstrong World Industries, Inc. Items are available in custom colors; contact ASQuote@armstrongceilings.com.
 - a. Item 8230 – 96" Suspension Bar for 3/8" FeltWorks Blades connector holes on both ends
 - b. Item 6651AB - 96" Suspension Bar End-to-End Connectors
 - c. Item 6655 – Blades Hanging Kit – Each kit includes 4 hanging assemblies, use on kit for each suspension.
 - 2. Or Approved Equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out.
- B. Proper designs for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

- A. Install suspension system and blades in compliance with the approval of the authorities having jurisdiction, and in accordance with the manufacturer's Installation Instructions.

3.4 ADJUSTING

- A. Replace damaged and broken panels.
- B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage.

END OF SECTION 09 54 46

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Thermoset-rubber base.
 - 2. Rubber molding accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish 20 linear feet of each type, color, pattern, and size of resilient product installed.

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.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.

3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE (B-01 and B-03)

- A. Manufacturers: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 1. Burke Mercer Flooring Products; a division of Burke Industries Inc.
 2. Johnsonite; a Tarkett company (Basis-of-Design).
 3. Roppe Corporation, USA.
 4. Approved Equal.
- B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
 1. Style and Location:
 - a. Style A, Straight: Provide in all areas with carpet.
 - b. Style B, Cove: Provide in all areas with resilient floor coverings or sealed concrete.
- C. Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Preformed.
- H. Colors: As indicated on drawings.
- I. Tested in accordance ASTM E648 or NFPA 253 and shall be not less than Class II.

2.2 RUBBER MOLDING ACCESSORY

- A. Description: Rubber cap for cove carpet, cap for cove resilient floor covering, carpet edge for glue-down applications, nosing for carpet, nosing for resilient floor covering, reducer strip for resilient floor covering, joiner for tile and carpet, transition strips.

- B. Profile and Dimensions: As indicated.
- C. Locations: Provide rubber molding accessories in areas indicated.
- D. Colors and Patterns: As selected by the architect from manufacturer's full range.

2.3 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 resilient-product manufacturer for resilient products and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths if practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13

SECTION 09 65 19 - RESILIENT TILE FLOORING

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. Solid vinyl floor tile.
- B. Related Requirements:
 - 1. Section 09 05 61.13 "Moisture vapor Emissions Control".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient floor tile.
 - 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 2. Show details of special patterns.
- C. Samples: Full-size units of each color, texture, and pattern of floor tile required.
- D. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile 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 floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

- A. Maintain ambient 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 periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient 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 tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with California Building Code, Section 11B-302.1.
 - 1. Resilient flooring shall be stable, firm and slip resistant.
- B. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 LUXURY VINYL FLOOR TILE (RF-3 thru RF-8, RF-11)

- A. Basis-of-Design: As indicated on drawings.

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- B. Tile Standard: ASTM F 1700.
 - 1. Class: Class III, Printed Film Vinyl Tile.
- C. Thickness: 4.5mm.
- D. Size: 12 in x 24 in, unless noted otherwise.
- E. Colors and Patterns: As indicated on drawings.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of 50 g/L or less.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 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 floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.

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3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 ph.
4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb. of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between

pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

- H. Adhere floor tiles to 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 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
- E. Cover floor tile until Substantial Completion.

END OF SECTION 09 65 19

SECTION 09 65 20 - RUBBER FLOORING

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. Proved Rubber sheet flooring in areas designated on the drawings.
- B. Section Includes:
 - 1. Rubber floor sheet.
 - 2. Resilient stair treads (one-piece nosing, tread and riser).
- C. Related Requirements:
 - 1. Section 03 30 00 "Cast-In-Place Concrete"

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of floor sheet. Include floor layouts, edges, columns, doorways, enclosing partitions, built in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- C. Samples for Verification: Full size units of each color and pattern of floor sheet required.
 - 1. For heat welding bead, manufacturer's standard size Samples, but not less than 9 inches long, of each color required.
- D. Welded Seam Samples: For seamless-installation technique indicated and for each flooring product, color, and pattern required; with seam running lengthwise and in center of 6 x 9 inch Sample applied to a rigid backing and prepared by Installer for this Project.
- E. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor sheet to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide resilient flooring manufactured by a firm with a minimum of 10 years' experience with resilient flooring of type equivalent to those specified.
 - 1. Manufacturer's quality management system must have ISO 9001:2000 approval.
 - 2. Provide resilient flooring products and accessories from one manufacturer to ensure compatibility.
 - 3. Manufacturer shall be capable of providing technical training and technical field service representation.

- B. Installer Qualifications: Acceptable to manufacturer of resilient flooring or INSTALL (International Standards & Training Alliance) resilient certified for the requirements of the project with a minimum of 4 years' experience with resilient flooring of type equivalent to those specified.
 - 1. It is recommended to have a minimum of one installer per working party with the ability to provide proof of current credentials at request.
 - 2. Has obtained and maintained current credentials from manufacturer's training program.
 - 3. Installers shall be able to exhibit proficient skills with flash cove detailing, both hot and cold-welding techniques, adhesives, specialty adhesive systems and seam cutting.
 - 4. The installing parties shall provide a submittal of their skills in the form of mock-ups of the specified material. These mock-ups will be accepted as proof of their skills and benchmarking for the proposed project.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in labeled packages. Store and handle in strict compliance with manufacturer's recommendations. Protect from damage due to weather, excessive temperatures, and construction operations.
- B. Deliver materials sufficiently in advance of installation to condition materials to the required temperature for 48-hours prior to installation.

1.7 FIELD CONDITIONS

- A. The General Contractor or Construction Manager shall be responsible for ensuring all site conditions meet the requirements of the Manufacturer, as referenced herein at parts 3.2 and 3.3.
- B. Concrete subfloors, on or below grade, must be installed over a permanent effective vapor retarder, respecting current versions of the standard practice ASTM E1643 and the standard ASTM E1745. The vapor retarder must be placed directly underneath the concrete slab, above the granular fill, as per Manufacturer's instructions. The vapor retarder must have a perm rating of 0.1 or less and must have a minimum thickness of 10 mil (0.010in).
- C. The installation area must be fully enclosed, weather tight, and climate controlled between 63°F and 75°F and 40% to 60% ambient relative humidity (RH) for at least 48 hours prior, during and 72 hours after installation (do not use gas fueled blowers). Dew point must be avoided. The substrate must be at least 5°F above dew point to be considered acceptable.
- D. Installation of the resilient flooring to be carried out no sooner than the specified curing time of concrete subfloor (normal density concrete curing time is approximately 28 days for development of design strength). Refer to current version of ASTM F710.
- E. The subfloor surface must be free of any paint, wax, oil, grease, sealer, curing compound, solvent or any other contaminants that may inhibit bond. All contaminants must be removed from the surface via mechanical abatement. Use of abatement chemicals is not recommended.
- F. Concrete to have smooth, dense finish, and be highly compacted with a tolerance of 1/8" in a 10ft radius (3.2mm in 3.05m radius). Floor Flatness (FF) and Floor Levelness (FL) numbers are not recognized.
- G. Moisture and alkalinity tests must be performed on all concrete substrates, under in-service conditions. It is recommended to turn on the HVAC unit prior to performing moisture testing, in order to ensure stable testing conditions and accurate results. The concrete's surface pH should be between 7 and 10. Relative humidity of the concrete slab must not exceed 85%, in accordance with ASTM F2170 (in situ probes). Moisture vapor emissions from the concrete slab must not exceed the tolerance of the adhesive specified, in accordance with ASTM F1869

(anhydrous calcium chloride).

- H. Installation of rubber flooring will not commence until the building is enclosed and all other trades have completed their work. It is the General Contractor or Construction Manager's responsibility to maintain a secure and clean working area before, during and after the installation of the resilient flooring.

1.8 WARRANTY

- A. Provide manufacturer's standard limited warranty for wear, defect, bond, and conductivity.

PART 2 – PRODUCTS

2.1 REGULATORY REQUIREMENTS

- B. Comply with California Building Code, Section 11B-302.1.
 - 1. Resilient flooring shall be stable, firm and slip resistant.

2.2 PERFORMANCE REQUIREMENTS

- C. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.3 RUBBER SHEET FLOORING [RF-1 and RF-2]:

- A. Products: Subject to compliance with requirements, provide the following:
 - 1. Mondo Rubber International, Inc; Zeus
 - 2. [Nora Systems \(Basis of Design\)](#)
- B. Product Name: noraplan® sentica™ 3.0 mm, Article 1701
 - 1. ASTM Specification: ASTM F1859 Standard Specification for Rubber Sheet Floor Covering Without Backing Type I
 - 2. Limited Wear Warranty: 15 years
 - 3. Material: nora vulcanized rubber compound 913 with environmentally compatible color pigments that are free of toxic heavy metals like lead, cadmium, or mercury
 - 4. Composition: Homogeneous rubber compound with a random scattered design
 - 5. Color: As indicated on finish schedule.
 - 6. Surface: Smooth
 - 7. Back of Sheet: Double-sanded smooth
 - 8. Thickness (ASTM F386): 0.12 inches (3mm)
 - 9. Flammability (E648/NFPA 253): ≥ 0.45 watts/sq. cm for Class 1 is required NBSIR 75 950, 1.03
 - 10. Smoke Density (ASTM E662/NFPA 258): < 450 is required NBS, 376 (flaming) and 256 (non-flaming)
 - 11. CAN/ULC-S102.2: Surface Burning, FSC1 of 125 and SD of 370
 - 12. Burn Resistance: Resistant to cigarette and solder burns
 - 13. Bacteria Resistance (ASTM E2180/ASTM G21): Resistant to bacteria, fungi, and micro-organism activity
 - 14. Indoor Air Quality: Greenguard Gold Certified for low VOC Emissions in compliance with CDPH 01350

15. Latex Allergies (ASTM D6499): Inhibition Elisa, results are below detection level
16. Sound Absorption (ASTM E2179/ISO 140): Δ IIC 14, Δ Lw 10dB (compare only Δ values)
17. Sound Generation: 67.2 dBA, 68.9 dBC and 20.9 Sones, independently tested
18. Cleaning: Cleaned and maintained effectively using water, nora pads and a suitable cleaning machine, without the use of any factory and/or field-applied coatings. Also, without using any chemicals that may be hazardous or containing any teratogenic, mutagenic or any other ingredients known to be carcinogenic. Refer to nora Maintenance Guidelines for product specific details.
19. Shine: Higher shine achieved by buffing without any artificial topical applied coatings.
20. Stain Removal: Samples of the product shall be provided for stain removal testing by the owner. Sample size shall be 24 inches by 24 inches, pre-cleaned by manufacture per published recommendations. Samples shall have no coatings, sealers, floor finish or other manually or mechanically applied finish on the surface of the product. Stain testing shall consist of application of common healthcare related disinfectants and chemicals to include, but not limited to, Betadine, Methylene Blue, Silver Nitrate, and alcohol-based hand sanitizer. Duration of test period shall be no less than one week. Removal of chemicals shall be in accordance with manufacturers published cleaning and maintenance recommendations.
21. Substrate Preparation: Per ASTM F710 and the nora Installation Instructions

2.4 RESILIENT STAIRTREADS (ONE-PIECE NOSING, TREAD AND RISER) [RF-10]:

- A. Products: Subject to compliance with requirements, provide the following:
 1. Nora Systems (Basis of Design)
 2. Or Approved Equal.
- B. Product Name: norament® round stairtreads, Articles 465 (4 foot), 466 (5 foot) and 467 (6 foot) (visually impaired strips available)
 1. ASTM Specification: ASTM F2169 Standard Specification for Resilient Stair Treads Type TS, Class 2, can be Group 1 and/or 2 and Grade 2
 2. Limited Wear Warranty: 15 years
 3. Material: nora vulcanized rubber compound 926 with environmentally compatible color pigments that are free of toxic heavy metals like lead, cadmium, or mercury
 4. Composition: Homogeneous
 5. Color: 16 standard colors
 6. Surface: Round pastille and smooth
 7. Back of Stair Tread: Double-sanded smooth
 8. Material Dimensions (ASTM F2169):
 - a. Length: as required.
 - b. Depth: as required.
 - c. Height 1.77 inches (45mm)
 - d. Thickness 0.18 inches (4.5mm)
 9. Flammability (E648/NFPA 253): ≥ 0.45 watts/sq. cm for Class 1 is required NBSIR 75 950, 1.1
 10. Smoke Density (ASTM E662/NFPA 258): < 450 is required NBS, 380 (flaming) and 230 (non-flaming)
 11. Burn Resistance: Resistant to cigarette and solder burns
 12. Slip Resistance (ASTM D2047): ≥ 0.5 is required Static coefficient of friction, Neolite dry 0.85, Neolite wet 0.76
 13. Bacteria Resistance (ASTM E2180/ASTM G21): Resistant to bacteria, fungi, and micro-organism activity
 14. Indoor Air Quality: Greenguard Gold Certified for low VOC Emissions in compliance with CDPH 01350

15. Oil & Grease Resistance (EN/ISO 26987): Yes
16. Static Generation (AATCC 134): < 2000 Volts at 20% RH
17. Cleaning: Cleaned and maintained effectively using water, nora pads and a suitable cleaning machine, without the use of any factory and/or field-applied coatings. Also, without using any chemicals that may be hazardous or containing any teratogenic, mutagenic or any other ingredients known to be carcinogenic. Refer to nora Maintenance Guidelines for product specific details.
18. Shine: Higher shine achieved by buffing without any artificial topical applied coatings.
19. Stain Removal: Samples of the product must be provided for stain removal testing by the owner. Sample size must be 24 inches by 24 inches, pre-cleaned by manufacture per published recommendations. Samples must have no coatings, sealers, floor finish or other manually or mechanically applied finish on the surface of the product. Stain testing must consist of application of common healthcare related disinfectants and chemicals to include, but not limited to, Betadine, Methylene Blue, Silver Nitrate, and alcohol-based hand sanitizer. Duration of test period must be no less than one week. Removal of chemicals must be in accordance with manufacturers published cleaning and maintenance recommendations.
20. Substrate Preparation: Per ASTM F710 and the nora Installation Instructions

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 floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Seamless-Installation Accessories:
 1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
 - a. Color: Match floor tile
 2. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Coordinate requirements specified in other Sections for substrate construction and tolerances to ensure that they are appropriate for floor tile.
- B. Ensure that concrete subfloors, on or below grade, are installed over a permanent effective vapor retarder, respecting current versions of the standard practice ASTM E1643 and the standard specification ASTM E1745. The vapor retarder must be placed directly underneath the concrete slab, above the granular fill, as per Manufacturer's instructions. The vapor retarder must have a perm rating of 0.1 or less and must have a minimum thickness of 10 mil (0.010in).
- C. Installation of the rubber flooring to be carried out no sooner than the specified curing time of concrete subfloor (normal density concrete curing time is approximately 28 days for development of design strength). Refer to current version of ASTM F710.
- D. Ensure that no concrete sealers or curing compounds have been applied to or mixed into the concrete.
- E. Subfloor surface must be free of any paint, wax, oil, grease, sealer, curing compound, solvent or any other contaminants that may inhibit bond. All contaminants must be removed from the surface via mechanical abatement. Use of abatement chemicals is not recommended.
- F. Confirm concrete has smooth, dense finish, and is highly compacted with a tolerance of 1/8" in

a 10ft radius (3.2mm in 3.05m radius). Floor Flatness (FF) and Floor Levelness (FL) numbers are not recognized.

- G. Moisture and alkalinity tests must be performed on all concrete substrates, under in-service conditions. It is recommended to turn on the HVAC unit prior to performing moisture testing, in order to ensure stable testing conditions and accurate results. The concrete's surface pH should be between 7 and 10. Relative humidity of the concrete slab must not exceed 85%, in accordance with ASTM F2170 (in situ probes). Moisture vapor emissions from the concrete slab must not exceed the tolerance of the adhesive specified, in accordance with ASTM F1869 (anhydrous calcium chloride).
- H. Maintain a stable room and subfloor temperature within the recommended range of 65oF to 86oF (18oC to 30oC), 48 hours prior to installation, during the installation, and 48 hours after the installation. Recommended ambient humidity control level is between 35 to 55%.
- I. Installation of rubber flooring will not commence until the building is enclosed and all other trades have completed their work. Ensure a secure and clean working area before, during and after the installation of the resilient flooring.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
 - 4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
 - 2. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile

3.3 FLOOR SHEET INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as

manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

- C. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- D. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door 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 marking device.
- F. Seamless Installation: Provide seamless installation per manufacturer's written instructions.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor sheet.
- B. Perform the following operations immediately after completing floor sheet 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.
- C. Protect floor sheet from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Joint Sealant: Apply sealant to resilient floor sheet perimeter and around columns, at door frames, and at other joints and penetrations.
- E. Cover floor until Substantial Completion.

END OF SECTION 09 65 20

SECTION 09 65 36 - STATIC-DISSIPATIVE RESILIENT FLOORING

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. Static-dissipative, floor tile.
 - 2. Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.
- B. Related Requirements:
 - 1. Section 09 65 13 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with static-control resilient flooring.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM E 648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
 - 2. ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
 - 3. ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
 - 4. ASTM F 1066 Standard Specification for Vinyl Composition Tile
 - 5. ASTM F 1482, Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring
 - 6. ASTM F 1861 Standard Specification for Resilient Wall Base
 - 7. ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
 - 8. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
 - 2. NFPA 258 Standard Test Method for Measuring the Smoke Generated by Solid Materials.
- C. ANSI/ESD Standards
 - 1. ANSI/ESD STM 7.1 :Floor Materials—Resistive Characterization of Materials

2. ANSI/ESD STM 97.1: Floor Materials and Footwear—Resistance in Combination with a Person
3. ANSI/ESD STM 97.2: Floor Materials and Footwear Voltage Measurement in Combination with a Person

1.4 ACTION SUBMITTALS

- A. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation and maintenance instructions for flooring and accessories.
- B. Submit the manufacturer's standard samples showing the required colors for flooring and applicable accessories.
- C. Submit Safety Data Sheets (SDS) available for adhesives, moisture mitigation systems, primers, patching/leveling compounds, floor finishes (polishes) and cleaning agents and Material Information Sheets for flooring products.
- D. Closeout Submittals: Submit the following:
 1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
 2. Warranty: Warranty documents specified herein

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for static-control resilient flooring.
 1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.
- B. Fire Performance Characteristics: Provide resilient vinyl composition tile flooring with the following fire performance characteristics as determined by testing material in accordance with ASTM test methods indicated below by a certified testing laboratory or other testing agency acceptable to authorities having jurisdiction:
 1. ASTM E 648 Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I
 2. ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less
- C. Provide flooring material to meet the following electrical properties when installed according to manufacturer's instructions with the required adhesive, copper strips and SDT floor finish:

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1. ANSI/ESD STM 7.1 Floor Materials—Resistive Characterization of Materials results between 106 and 109 ohms, point-to-point and point-to-ground.
2. ASTM F 150 Electrical Resistance of Flooring between 106 and 109 ohms, point-to-point and point-to-ground.
3. ANSI/ESD STM 97.1: Floor Materials and Footwear—Resistance in Combination with a Person results between 106 and 109 ohms (average) with dissipative footwear and when using heel straps.
4. ANSI/ESD STM 97.2: Floor Materials and Footwear Voltage Measurement in Combination with a Person – 30 volts (average) with dissipative footwear at 12% relative humidity.
5. Static Dissipation @ 12% RH: Flooring in combination with a person wearing dissipative footwear – 1000 to 100 volts: 0.2 seconds maximum.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store static-control resilient flooring 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.
 1. Floor Tile: Store on flat surfaces.
- B. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- D. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

1.8 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive static-control resilient flooring during the following time periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient 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 static-control resilient flooring installation.
- D. Close spaces to traffic for 48 hours after static-control resilient flooring installation.

- E. Install static-control resilient flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Static-Dissipative Properties: Provide static-control resilient flooring with static-control properties indicated as determined by testing identical products per test method indicated by an independent testing and inspecting agency.
 - 1. Electrical Resistance: Test per ESD-STM-7.1.
 - a. Average greater than 1 megohm and less than or equal to 1000 megohms when test specimens are tested surface to ground.
 - b. Average greater than 1 megohm and less than or equal to 1000 megohms when installed floor coverings are tested surface to ground.
 - 2. Static Generation: Less than 400 V when tested per AATCC-134 at 20 percent relative humidity with conductive footwear.
 - 3. Static Decay: 5000 to zero V in less than 0.01 seconds when tested per FED-STD-101C/4046.1.

2.2 STATIC-DISSIPATIVE RESILIENT FLOOR COVERINGS

- A. Resilient tile flooring, wall base, adhesives and subfloor preparation products and accessories:
 - 1. Armstrong Flooring Inc., 2500 Columbia Avenue, Lancaster, PA 17604, www.armstrongflooring.com/commercial
 - 2. Or Approved Equal.
- B. Static-Dissipative Floor Tile (SDT-1): ASTM F1344; except in manufacturer's standard hardness when tested per ASTM D2240 using Shore, Type A durometer.
 - 1. Smooth-Surface Floor Tile: Class I-B (homogenous rubber, through-mottled pattern).
 - a. Basis-of-Design: Excelon SDT™ Static Dissipative Tile Flooring manufactured by Armstrong Flooring Inc.
 - b. Description: Static dissipative vinyl tile composed of polyvinyl chloride resin, plasticizers, fillers, pigments, and antistatic additive with colors and texture dispersed uniformly throughout its thickness.
 - c. Tile shall meet size, thickness, indentation, impact, deflection, dimensional stability, resistance to chemicals, squareness, and resistance to heat requirements of ASTM F 1066 Standard Specification for Vinyl Composition Tile, Class 2, through pattern.
 - d. Pattern and Color: Refer to finish schedule.
 - e. Size: 12 in. x 12 in.
 - f. Thickness: 1/8"/0.125 in. (3.2mm)

2.3 INSTALLATION MATERIALS

- A. Provide Armstrong S-202 Static Dissipative Tile Adhesive with 2 in. (5.08 cm) wide x 24 in. (60.96 cm) long copper ground-connection strips for under the tile and Armstrong S-725 Wall Base Adhesive at the wall base as recommended by the flooring manufacturer.
- B. For top set wall base: Refer to finish schedule and specification section 09 65 13.
- C. Provide Armstrong S-392 Static Dissipative Tile Polish for application as initial and on-going static dissipative maintenance finish.
- D. For sealing joints between the top of wall base or integral cove cap and irregular wall surfaces such as masonry, provide plastic filler applied according to the manufacturer's recommendations.
- E. Provide transition/reducing strips tapered to meet abutting materials.
- F. Provide threshold of thickness and width as shown on the drawings.
- G. Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.
- H. Provide metal edge strips of width shown on the drawings and of required thickness to protect exposed edges of the flooring. Provide units of maximum available length to minimize the number of joints. Use butt-type metal edge strips for concealed anchorage, or overlap-type metal edge strips for exposed anchorage. Unless otherwise shown, provide strips made of extruded aluminum with a mill finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. 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 or static-control characteristics of floor coverings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of static-control resilient flooring and electrical continuity of floor-covering systems.
- B. Concrete Substrates: Prepare according to ASTM F710.

STATIC-DISSIPATIVE RESILIENT FLOORING

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1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with floor-covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
 - a. Perform anhydrous calcium chloride test according to ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Perform relative-humidity test using in situ probes according to ASTM F2170. Proceed with installation only after substrates have maximum 75 percent relative-humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install static-control resilient flooring until it is same temperature as space where it is to be installed.
1. Move static-control resilient flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum substrates to be covered by static-control resilient flooring immediately before installation.

3.3 INSTALLATION, GENERAL

- A. Install static-control resilient flooring according to manufacturer's written instructions.
- B. Embed grounding strips in static-control adhesive. Extend grounding strips beyond perimeter of static-control resilient floor-covering surfaces to ground connections.
- C. Scribe, cut, and fit static-control resilient flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- D. Extend static-control resilient flooring into toe spaces, door reveals, closets, and similar openings. Extend static-control resilient flooring to center of door openings.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on static-control resilient flooring as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- F. Install static-control resilient flooring on covers for telephone and electrical ducts, and similar items in installation areas. Maintain overall continuity of color and pattern with pieces of static-control resilient flooring installed on covers. Tightly adhere static-control resilient flooring edges to substrates that abut covers and to cover perimeters.

- G. Adhere static-control resilient flooring to substrates using a full spread of static-control 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 FLOOR-TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half floor tile at perimeter.
- C. Match floor tiles for color and pattern by selecting floor tiles from cartons in same sequence as manufactured and packaged if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.
- D. In each space where conductive, solid vinyl floor tile is installed, install maintenance floor tile identifying conductive floor tile in locations approved by Architect.
- E. Apply top set wall base to walls, columns, casework, and other permanent fixtures in areas where top-set base is required. Install base in lengths as long as practical, with inside corners fabricated from base materials that are mitered or coped. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.
- F. Fill voids with plastic filler along the top edge of the resilient wall base or integral cove cap on masonry surfaces or other similar irregular substrates.
- G. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.

3.5 FIELD QUALITY CONTROL

- A. Testing: Engage a qualified testing agency to test electrical resistance of static-control resilient flooring for compliance with requirements.
 - 1. Arrange for testing after static-control adhesives have fully cured and static-control resilient flooring has stabilized to ambient conditions and after ground connections are completed.
- B. Static-control resilient flooring will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of static-control resilient flooring.

- B. Perform the following operations immediately after completing static-control resilient flooring:
 - 1. Remove static-control adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect static-control resilient flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
 - 1. Do not wax static-control resilient flooring.
- D. Cover static-control resilient flooring until Substantial Completion.

END OF SECTION 096536

SECTION 09 67 23 - RESINOUS FLOORING

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 resinous flooring systems.
- B. Provide all labor, materials, equipment and supervision as necessary to install a surface-applied, chemical resistant, decorative colored quartz epoxy resin broadcast system including cove base that shall consist of primer coat, and lock/seal coat on (new or existing) concrete floor slabs, as shown on the project drawings and as outlined in this specification.

1.3 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete
- B. Section 03 35 00 – Concrete Finishing
- C. Section 07 26 00 – Vapor Retarders
- D. Section 07 92 00 – Joint Sealants
- E. Section 09 90 00 – Painting and Coating

1.4 REFERENCES

- A. ASTM C109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
- B. ASTM C190: Method of Test for Tensile Strength of Hydraulic Cement Mortars.
- C. ASTM C580: Standard Test Method for Flexural and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
- D. ASTM F1869-04: Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Sub- floor Using Anhydrous Calcium Chloride.
- E. ASTM F2170-11: Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in Situ Probes.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.
- C. Material certificates signed by the manufacturer certifying that the decorative color quartz broadcast flooring and all components of the system comply with all requirements specified herein.
- D. Warranties: Submit a sample of the manufacturer's standard material warranty and the contractor's labor warranty.
- E. Project Reference List: Contractor shall submit a minimum of 5 recently completed projects that entailed a similar scope of work and include total contract value.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: The manufacturer of the products specified in this section shall have a minimum of 5 years' experience in the production of these types of products.
- B. Contractor Qualifications: The contractor installing the products specified in this section shall have a minimum of 3 years' experience and have successfully completed no less than 5 projects similar in scope and complexity and is acceptable to and has been trained by the manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- B. Store materials to comply with manufacturer's directions to prevent from damage and/or deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.
- D. Protection: Protect newly installed mechanical equipment flooring system from rain or other potentially harmful climatic conditions for a minimum of 24 hours, from potential damage due foot or vehicular traffic and/or from the work of other trades.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Flammability: Self-extinguishing according to ASTM D635.
- B. Comply with California Building Code, Section 11B-302.1.
 - 1. Floor and ground surfaces shall be stable, firm, and slip resistant and shall comply with Section 11B-302.

2.2 MANUFACTURERS

- A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

2.3 RESINOUS FLOORING

- A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide MiraFlor CQ Broadcast System by Miracote, Division of Crossfield Products Corp., or approved equal.
- B. Materials:
 - 1. MiraFlor CQ Broadcast System is a multi-layered, chemical resistant, decorative colored quartz broadcast flooring system consisting of a primer coat, one or two epoxy broadcast coats, colored quartz broadcast aggregate, and a lock/seal coat.
- C. System Components: Manufacturer's standard components that are compatible with each other and as follows:

1. MiraPrime C – Two-component epoxy primer. (Acceptable primer substitute, MiraFlor CQ Clear)
2. MiraFlor CQ Clear – Two-component epoxy resin base, intermediate, and lock/seal coats.
3. MiraFlor Color Quartz Aggregate – Broadcast medium.

D. System Physical Properties: Provide a clear, two-component, 100% solids, low-odor, flexible, high-build epoxy resin material that meets or exceeds the listed minimum physical property requirements when tested in accordance with the referenced standard test method.

1. Compressive Strength ASTM D579 (Resin/Hardener/Aggregate): 10,000 psi
2. Tensile Strength ASTM C307 (Resin/Hardener/Aggregate): 1,800 psi
3. Flexural Strength ASTM C580 (Resin/Hardener/Aggregate): 4,000 psi
4. Surface Hardness ASTM D2240 Shore D: 85-85
5. Adhesion ASTM D4541: >400 psi
(100% failure in concrete substrate)
6. Water Absorption MIL-D-3134: <1%
7. Abrasion Resistance ASTM D4060: 0.09 gr
(CS17, 1000gr load, 1000 cycles)
8. Flammability ASTM D635: Self-extinguishing (Bonded to concrete)
9. Microbial Resistant ASTM G61: Passes Rating 1
10. VOC: 3 g/L

2.4 ACCESSORY MATERIALS

- A. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.
- B. Waterproofing Membrane: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.
- C. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine all construction substrates and conditions where the decorative color quartz broadcast flooring system is to be installed. Notify the Specifying Authority of any unsatisfactory conditions that may be detrimental to the proper and timely completion of the work.
- B. Do not proceed with the work until all such deficiencies have been corrected by the Contractor in an acceptable manner, and as approved by the Specifying Authority.

3.2 PREPARATION

- A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

- B. Protect all surrounding areas, walls, window glass, landscaping and other adjacent surfaces from the execution of each item of work including, but not limited to, surface preparation and all application steps involved in the installation of the decorative color quartz broadcast flooring system.
- C. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - 1. Roughen concrete substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
 - 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
 - 3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 7 lb of water/1000 sq. ft. of slab area in 24 hours.
 - b. Relative Humidity Test: Use in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 85 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.
 - 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- D. Perform surface and crack repairs as necessary to re-profile, re-level or to restore the integrity of the concrete substrate or other surfaces in general, as directed by the specifying authority. Concrete surface repair products shall be from the same manufacturer, or as approved by the manufacturer of the decorative color quartz broadcast flooring system specified herein. Provide letter from the manufacturer of the surface repair materials verifying compatibility with the specified decorative color quartz broadcast flooring system.
- E. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
 - 1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.
- F. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

3.3 APPLICATION

- A. General: Follow all manufacturers' directions, as published in their product technical data sheets and/or available installation guidelines regarding the application of the decorative color quartz broadcast flooring system, as specified herein.
- B. Joint Sealants: At the direction of the specifying authority, install backer rod and polyurethane sealant at joints, transitions, and penetrations. Detail all existing concrete slab cracks in accordance with manufacturer's installation guidelines.
- C. Mixing: MiraFlor CQ Broadcast System clear epoxy resin components must be mixed mechanically using a low-speed drill (300-450 rpm) until blended with a "Jiffy-type" or similar Miracote-approved mixing paddle. Empty entire contents of component A and component B into a clean mixing vessel. Mix for approximately 3 minutes keeping the mixing head fully immersed at all times. At least once when mixing, stop to scrape down the sides and bottom of the pail to ensure thorough blending of both components. If not mixing full units, each component must be pre-mixed individually ensuring uniformity prior to use. Once completely mixed and in observance of pot life, dispense material immediately from the pail to the substrate.
- D. Priming Coat: When mixed pour out (MiraPrime C or MiraFlor CQ) or other suitable primer in a ribbon across the concrete surface to receive broadcast. Using a flat squeegee, spread the material at a rate of 200- 250 SF per gallon evenly left to right, and back-roll using only a 3/16" or 1/4" maximum nap roller. Allow the primer to dry until it is completely tack free.
- E. Broadcast Coat: Pour out mixed epoxy broadcast coat in a large ribbon across the primed concrete surface as soon as it becomes tack free. Spread evenly at a rate of 160 SF per gallon with a notched squeegee, and back-roll epoxy with a high quality 1/4" nap roller to achieve millage consistency of the wet film and broadcast aggregate immediately. Repeat in the same manner when installing a double broadcast system, with a spread rate of 65 SF per gallon.
- F. Broadcast Aggregate: Immediately broadcast quartz aggregate in a rainfall pattern over the epoxy base coat at a rate of 1 LB per square foot until refusal ensuring a smooth and even quartz surface. Continue to broadcast color quartz to excess until there are no visible areas of glistening resin. Allow broadcasted epoxy base coat to cure then sweep and vacuum excess quartz aggregate. Repeat in the same manner when installing a double broadcast system.
- G. Lock/Seal Coat: When mixed pour out epoxy or other resinous lock/seal coat of choice in a ribbon across the broadcast quartz surface, and spread the material evenly with a flat squeegee at a rate of 65 – 120 SF per gallon to ensure consistent millage uniformity. Finish with a back-roll using a 1/4" maximum nap roller.
- H. Allow completed decorative color quartz broadcast flooring system to cure for 24 hours before subjecting to foot traffic.

3.4 TERMINATIONS

- A. Chase edges to "lock" the flooring system into the concrete substrate along lines of termination.
- B. Penetration Treatment: Lap and seal the flooring system onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.

- C. Trenches: Continue flooring system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.
- D. Treat floor drains by chasing the flooring system to lock in place at point of termination.

3.5 JOINTS AND CRACKS

- A. Treat control joints to bridge potential cracks and to maintain monolithic protection.
- B. Treat cold joints and construction joints to bridge potential cracks and to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.
- C. Discontinue floor coating system at vertical and horizontal contraction and expansion joints by installing backer rod and compatible sealant after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered.

3.6 FIELD QUALITY CONTROL

- A. Material Sampling: Owner may, at any time and any number of times during resinous flooring application, require material samples for testing for compliance with requirements.
 - 1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 - 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.7 CLEANING, PROTECTING, AND CURING

- A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 18 hours.
- B. Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surfaces after final coats.
- C. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer. Clean work area and remove/discard all debris resulting from the application of the decorative color quartz broadcast flooring system to the acceptance of the specifying authority or the owner.

END OF SECTION 09 67 23

SECTION 09 68 13 - 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. Section Includes:
 - 1. Modular carpet tile.
- B. Related Requirements:
 - 1. Section 09 65 13 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.
 - 2. Section 09 05 61.13 "Moisture Vapor Emissions Control".
 - 3. Section 12 48 13 "Entrance Floor Mats" for carpet type walk-of-mats.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.

3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

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. Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.

F. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. 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.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

1.9 FIELD CONDITIONS

- A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- 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.

1.10 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty 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, the following:
 - a. More than 10 percent edge raveling, snags, and runs.
 - b. Dimensional instability.
 - c. Excess static discharge.
 - d. Loss of tuft-bind strength.
 - e. Loss of face fiber.
 - f. Delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with California Building Code, Section 11B-302.2.
 - 1. Carpet or carpet tile shall be securely attached and shall have a firm cushion, pad, or backing or no cushion or pad. Carpet or carpet tile shall have a level loop, textured loop, level cut pile, level cut/uncut pile texture. Pile height shall be 1/2-inch (12.7 mm) maximum.
 - 2. Exposed edges of carpet shall be fastened to floor surfaces and shall have trim on the entire length of the exposed edge. Carpet edge trim shall comply with CBC Section 11B-303.

TILE CARPETING

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2.2 CARPET TILE (CPT-1 thru CPT-6)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in Interior Finish Schedule, or approved equal.
- B. Color and Pattern: As indicated on drawings.
- C. Primary Backing/Backcoating: Synthetic.
- D. Size: As indicated.
- E. Applied Treatments:
 - 1. Soil-Resistance Treatment: Manufacturer's standard treatment.
- F. Performance Characteristics:
 - 1. Antimicrobial Assessment Passes (AATCC-174)
 - 2. Methenamine Pill Test Passes (DOCFF-1-70)
 - 3. Critical Radiant Flux Not less than Class II (ASTM E-648)
 - 4. NBS Smoke < 450 (ASTM-E-662)
 - 5. Electrostatic Propensity Less than 3.5 kV (AATCC-134)

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
 - 1. Adhesives shall have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. 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.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

TILE CARPETING

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1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas. Where moisture emissions are above manufacturer's recommendations, provide products as indicated in Section 09 0561.13 "Moisture vapor Emissions Control" and re-test the substrate.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb. of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

TILE CARPETING

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- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive 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 the Carpet and Rug Institute's CRI 104, Section 13.7.
- 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 09 68 13

SECTION 09 72 00 - WALL COVERINGS

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. Vinyl wall covering.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.
- B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, seams and termination points.
- C. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36-inch-long in size.
- D. Product Schedule: For wall coverings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

WALL COVERINGS

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1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 5 percent of amount installed.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.
- B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Wall materials shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.2 VINYL WALL COVERING (WC-1)

- A. Basis-of-Design Products: As indicated in Interior Finish Schedule, or approved equal.
- B. Colors, Textures, and Patterns: As indicated.
- C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: Class A (25 or less).
 2. Smoke-Developed Index: 450 or less.

2.3 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.
 1. Adhesives shall have a VOC content of 50 g/L or less.

WALL COVERINGS

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
 - 2. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - a. Provide level 5 finish on gypsum board substrate for custom printed vinyl wallcovering.
 - 3. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.
- E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 WALL-COVERING INSTALLATION

- A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.
- B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.

WALL COVERINGS

09 72 00 - 3

1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.
- D. Install wall covering without lifted or curling edges and without visible shrinkage.
- E. Install seams vertical and plumb at least 6 inches from outside corners and 3 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.
- F. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.
- G. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.4 CLEANING

- A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 09 72 00

SECTION 09 72 16 – CUSTOM DIGITAL WALL COVERING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Custom Digital Wall Covering

1.02 REFERENCES

- A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the contract documents.
- B. American Society for Testing and Materials (ASTM):
 - 1. E84 - Test Method for Surface Burning Characteristics of Building Materials. Tested on re-enforced cement board. Flame Spread Index 0-25.
 - 2. G21 - Recommended Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- C. EPA Pesticide Regulations, 40 C.F.R. 152.25
- D. Chemical Fabrics and Film Association (CFFA):
 - 1. CFFA - W - 101-D - Quality Standard for Vinyl Coated Fabric Wall Covering.

1.03 SUBMITTALS

- A. Submit samples of all materials specified. Do not order materials until approval is received.
 - 1. Submit "mini-mural" of complete finished image printed on actual substrate specified.
 - 2. Submit sample section of final image at 100% resolution printed on actual substrate specified.
- B. Submit full size miniature strike-off for approval prior to the manufacturing of full size mural.
- C. Submit Installer's qualifications and certification of experience.
- D. Manufacturer's Data: For each type of digital wall covering proposed for use. Submit certified copies of reports of tests specified, together with complete description of each wall covering, including: patter, total weight, fabric backing, tensile strength, tear strength, and fire hazard classification.

1.04 QUALITY ASSURANCE

- A. Imperfections such as engraving roller die marks, roller repeat marks or other features deemed not in conformance with the specified materials, are not acceptable.

- B. Tests: All tests shall be performed in accordance with Federal Specification CCC-T-408A, except as follows:
 - 1. Adhesion of vinyl coating to the fabric backing shall be tested in accordance with ASTM D 751.
 - 2. Materials shall have a zone of inhibition rating of "0" on face, and "1" on backing to resist the growth of mildew and bacteria, as determined by test method ASTM G 21.
- C. Applicators Qualifications: Work of this section shall be performed by a firm regularly engaged in the installation of vinyl wall coverings of the types and qualities specified. Minimum experience 3 years.

1.05 PROJECT SITE CONDITIONS

- A. Lighting: Provide not less than 80-foot candles per square foot minimum, on the surfaces to receive wall coverings.
- B. Wall Condition:
 - 1. The wall surface should be clean, dry, structurally sound, and free of mildew, grease, dust, or other stains.
 - 2. Existing wall covering and adhesive should be completely removed from the wall.
 - 3. Plaster and masonry wall surfaces should not exceed 5.5% moisture when measured by a moisture meter. Gypsum board wall surfaces should not exceed 16% moisture.
 - 4. Room humidity should not exceed 90%.
 - 5. Wall surfaces should be primed with a good quality wall covering primer. Wall surfaces with significant color variation should be primed with a good quality pigmented wall covering primer.
 - 6. New plaster should cure for 60-90 days before painting or installing wall covering.
- C. Temperatures
 - 1. Maintain substrate surface and ambient temperatures above 65 degrees F,
 - 2. unless required otherwise by manufacturer's instructions.
 - 3. Do not apply adhesive when substrate surface temperature or ambient temperature is below 65 degrees F.
 - 4. Maintain these conditions 72 hours before, during, and after installation of vinyl wall covering.

1.06 WARRANTY

- A. Submit manufacturer's written five-year warranty against manufacturing defects.
 - 1. All wall covering materials when adhered to a sound surface with the manufacturer's recommended procedures and adhesive, shall be warranted free of manufacturing defects for a period of 5 years from the date of acceptance of the project.
 - 2. Assuming no deterioration in the subsurface, if such manufacturing defects are claimed in writing during the warranty period, and proper documentation is

presented to the manufacturer with regard to date of sale, plus adhesive used and surface applied to the manufacturer, as its option, will either replace the vinyl wall covering or refund the purchase price.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. MDC Wall Coverings, Elk Grove, IL.
- B. Koroseal Interior Products, LLC.
- C. Or equal in accordance with Division 01 for Substitutions.

2.02 MATERIALS

- A. Basis of Design: MDC Digital Wall Covering: Printed on 54" vinyl wall covering substrate using piezo drop-on-demand technology incorporating eight colors. CYMK (cyan, magenta, yellow, black) and half density CYMK. Printed image shall be dried from both front and back using combinations of IR and platen heaters to prevent media distortion.
 - a. Type II Vinyl Wallcovering - Smooth finish
 - b. Total Weight: 20 ounces per linear yard min.
 - c. Fabric Weight: 3 ounces per linear yard min.
 - d. Vinyl Weight: 17 ounces per linear yard min.
 - e. Fabric backing and content: Poly-Cotton Woven
 - f. Thickness: 0.017 to 0.027 in. depending on texture
- B. Adhesive: Heavy Duty Clay or Heavy Duty Clear or brands approved as equals by the manufacturer.
- C. Substrate Primer/Sealer: Alky or acrylic/latex approved by manufacturer.
- D. Topcoat Protection: Stain protection applied to surface to minimize migration of stains into vinyl. Clear coating:
 - a. Dream Guard Protex 3, or equal.
 - b. Manufacturer's standard coating.
 - c. Finish: Matte Finish.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Examine surface for any imperfections. Repair surfaces acceptable to manufacturers.
- B. Install digital wall covering in accordance with the manufacturer's instructions using heavy-duty vinyl wall covering adhesive recommended by the manufacturer (Wheat paste shall not be used).
- C. Before cutting, lay out panels in numeric order and examine each panel for color consistency, accuracy and proper image dimension.

- D. Install each panel in numerical sequence hanging first panel to a vertical line. Overlap subsequent panels to match crop lines and double cut on the wall. Salvage (excess trimmed edge) should be removed from the wall and the seam closed within one hour.
- E. Re-inspect after the application of each panel. Request inspection by the Architect if there are variations in color or pattern that are excessive. The wall covering manufacturer's representative shall then be notified for their inspection, before any further wall covering is installed.
- F. The wall covering shall be smoothed to the hanging surface, using a stiff bristled sweep brush or a flexible broad knife to eliminate air bubbles.
- G. Remove excess adhesive along finished seams immediately after each wall-covering strip is applied. Use clean warm water, a natural sponge, and clean towels. Change water often to maintain water cleanliness.
- H. Apply protection coat per manufacturer's instructions. Apply with low nap (1/4) latex paint roller, follow manufacturer's recommendations for even coat.
- I. If wallcovering does not end at a corner – provide walltalkers J-Cap trim piece.

3.02 CLEAN UP

- A. Upon completion of the work, remove surplus materials, rubbish and debris resulting from the wall covering installation. Leave areas in neat, clean and orderly condition.

END OF SECTION 09 72 16

SECTION 09 72 17 – FIBERGLASS REINFORCED PLASTIC PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fiberglass Reinforced Plastic Wall Panels.
 - 2. Components and moldings.
 - 3. Sealants

1.3 REFERENCE STANDARDS

- A. Conform to reference standards by date of issue current on date of Contract Documents.
- B. USDA - United States Department of Agriculture.
- C. ASME E84 - Surface Burning Characteristics of Building Materials.
- D. AQMD, Local Regulations.

1.4 ACTION SUBMITTALS

- A. Product data.
- B. Manufacturer's current recommended method of installation.
- C. Three (3) sets of samples of panels and molding illustrating color, texture, thickness and physical characteristics.
- D. Certification of USDA approval for use of material in food handling facilities.

1.5 QUALITY ASSURANCE

- A. Product Manufacturer: Company specializing in manufacturing products specified herein with minimum ten years' experience.
- B. Applicator: Company specializing in installation of specified products with minimum five years' experience.
- C. Flame spread classification requirements

FIBERGLASS REINFORCED PLASTIC PANELS

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1. ASTM E84, Class I/A flame spread less than 25, smoke density less than 450.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the project site with manufacturer's labels intact and legible.
- B. Handle materials with care to prevent damage.
- C. Deliver materials bearing USDA accepted label and required classification numbers.
- D. Store materials under cover, stacked flat, off floor.
- E. Stack panels so that long lengths are not over short lengths.

1.7 FIELD CONDITIONS

- A. Maintain temperature range between 55 degrees F. to 70 degrees F. for 24 hours before, during and after gypsum wallboard and joint treatment applications.
- B. Provide ventilation during and following sealing of joints.
- C. Adhesives shall conform to AQMD, Local Regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products of the following manufacturers form the basis for design and quality intended.
 1. Marlite Inc., Dover, OH.
 2. Kemlite/Crane Co., Joliet, IL.
 3. Nudo Products, Inc., Springfield, IL.
 4. Glasteel, Division of Stabilit America, Inc., Collierville, TN.
 5. Parkland Plastics, Middlebury, IN.
- B. Or equal as approved in accordance with Division 01, General Requirements for substitutions.

2.2 MATERIALS

- A. MARLITE FRP PANELS; Class A, 3/32-inch-thick, interior liner panels, chemical, stain, odor, moisture and impact resistant. Panels shall not support mold or mildew. Surface: Pebble.
- B. Colors and Materials: Pebbled - P100 White.

2.3 ACCESSORIES

- A. Moldings: Aluminum Designs and thickness shall match panels. Provide at all edges, divider joints, interior corners and exterior corners.

FIBERGLASS REINFORCED PLASTIC PANELS

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- B. Sealant: MS250 clear, one-part silicone, conforming to requirements of Section 07 92 00.
- C. Adhesive: C375 neoprene based or C551 latex based construction adhesive, VOC Compliant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive the work of this section.
- B. Verify that gypsum board substrate has been taped and sanded, all joints.
- C. Beginning of installation means installer accepts existing surfaces.

3.2 INSTALLATION

- A. Install panels plumb, level and with all vertical joints on bearing.
- B. Verify location and install all trim required. Install all trim and sealant in accordance with the manufacturer's recommendations.

3.3 CLEANING AND PROTECTION

- A. Do not allow the accumulation of debris, immediately remove spilled or splashed material and all trace of residues.

END OF SECTION 09 72 17

SECTION 09 77 23 - FABRIC-WRAPPED PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes shop-fabricated, fabric-wrapped wall panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for acoustical / tackable wall panels, including plans, elevations, sections, details, and attachments to other Work.
- C. Samples for Verification: 8 by-11 inch units of each type of acoustical / tackable wall panel indicated; in sets for each color, texture, and pattern specified for facing materials, showing the full range of variations expected in these characteristics. Include samples of installation devices and accessories.
- D. Product Certificates: Signed by manufacturers of acoustical wall panels certifying that products furnished comply with requirements.
- E. Maintenance Data: For acoustical wall panels and facings to include in maintenance manuals specified in Division 01.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fabric: For each fabric, color, and pattern installed, provide length equal to 10 percent of amount installed, but no fewer than 10 sq. yd., full width of bolt.
 - 2. Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than five devices, including unopened adhesives.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing acoustical / tackable wall panels similar to those indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations for Acoustical Wall Panels: Obtain acoustical wall panels from one source with resources to provide products of consistent quality in appearance and physical properties.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and panel manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install panels until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install panels until a lighting level of not less than 50 fc is provided on surfaces to receive the panels.
- C. Air-Quality Limitations: Protect panels from exposure to airborne odors such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify panel locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace panels and components that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Fabric sagging, distorting, or releasing from panel edge.
 - b. Warping of core.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fabric-wrapped wall panels from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Panels shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

2.3 FABRIC-WRAPPED WALL PANELS

- A. Fabric-Wrapped Acoustical Wall Panel (AWP-1 thru AWP-5): Manufacturer's standard construction with facing material stretched over core.
1. Basis-of-Design Product: As indicated in Interior Finish Schedule or approved equal.
 2. Panel Shape: Flat.
 3. Core Materials: 100% PET
 4. Edge Construction: Chemically hardened core.
 5. Reveals between Panels: As indicated.
 6. Facing Material: As indicated.
 7. Nominal Thickness: 1" (0.98") as indicated.
 8. Panel Size and layout: As indicated.
- B. Fabric-Wrapped Tackable Wall Panel (FWP-1 thru FWP-4): Manufacturer's standard construction with facing material stretched over core.
1. Basis-of-Design Product: As indicated in Interior Finish Schedule or approved equal.
 2. Panel Shape: Flat.
 3. Core Materials: Mineral-fiber board
 4. Edge Construction: Chemically hardened core.
 5. Corner Detail in Elevation: As indicated.
 6. Reveals between Panels: As indicated.
 7. Facing Material: As indicated.
 8. Nominal Thickness: 1" as indicated.
 9. Panel Size and layout: As indicated.

FABRIC-WRAPPED PANELS

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2.4 MATERIALS

- A. Core Materials: Manufacturer's standard.
 - 1. Glass-Fiber Board: ASTM C 612; of type standard with manufacturer; nominal density of 6 to 7 lb/cu. ft., unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
 - 2. Mineral-Fiber Board: Maximum flame-spread and smoke-developed indexes of 25 and 10, respectively.
- B. Facing Material: Fabric from same dye lot; color and pattern as indicated.
- C. Mounting Devices: Concealed on back of panel, recommended by manufacturer to support weight of panel, and as follows:
 - 1. Metal Clips or Bar Hangers: Manufacturer's standard two-part metal "Z" clips, with one part of each clip mechanically attached to back of panel and the other part to substrate, designed to permit unit removal.

2.5 FABRICATION

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Edge Hardening: For glass-fiber board cores, chemically harden core edges and areas of core where mounting devices are attached.
- C. Facing Material: Apply fabric fully covering visible surfaces of panel; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
 - 1. Square Corners: Tailor corners.
 - 2. Radius and Other Nonsquare Corners: Attach material so there are no seams or gathering of material.
 - 3. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent panels.
- D. Dimensional Tolerances of Finished Panels: Plus or minus 1/16 inch for the following:
 - 1. Thickness.
 - 2. Edge straightness.
 - 3. Overall length and width.
 - 4. Squareness from corner to corner.
 - 5. Chords, radii, and diameters.
- E. Back Mounting Accessories: Manufacturer's standard or recommended accessories for securely mounting panels, of type and size indicated, to substrates provided.
- F. Sound Absorption Performance: Provide acoustical / tackable wall panels with minimum noise reduction coefficients of NRC 0.85, as determined by testing per ASTM C 423 for mounting type

specified under individual product requirements. The fabric used to wrap the panel should not compromise the acoustical performance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabric, fabricated panels, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting panel performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panels in locations indicated. Unless otherwise indicated, install panels with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of panels using type of mounting devices indicated. Mount panels securely to supporting substrate.
- C. Align fabric pattern and grain with adjacent panels and as indicated on Drawings.

3.3 INSTALLATION TOLERANCES

- A. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, and scribed to fit adjoining work accurately at borders and at penetrations. Comply with panel manufacturer's written instructions for installation of panels using type of mounting accessories indicated or, if not indicated, as recommended by manufacturer.
- B. Variation from Plumb and Level: Plus or minus 1/16 inch in 48 inches, noncumulative.
- C. Variation of Joint Width: Not more than 1/16 inch wide from reveal line in 48 inches, noncumulative.

3.4 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.
- C. Remove surplus materials, rubbish, and debris resulting from acoustical wall panel installation, on completion of the Work, and leave areas of installation in a neat and clean condition.

3.5 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure acoustical wall panels are without damage or deterioration at time of Substantial Completion.
- B. Replace panels that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 097723

SECTION 09 91 13 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on exterior substrates.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 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.

1.7 FIELD 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Dunn-Edwards Corporation (a Nippon Paint Holdings Co. Ltd. company).
 - 2. Frazee, Sherwin-Williams Company (The).
 - 3. Vista Paint Corporation.
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include but are not limited to products listed in the finish schedule on drawings.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

EXTERIOR PAINTING

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- C. Colors: As indicated on drawings.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
 2. Fiber-Cement Board: 12 percent.
 3. Wood: 15 percent.
 4. Portland Cement Plaster: 12 percent.
 5. Gypsum Board: 12 percent.
- C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.
- D. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- F. Proceed with coating application only after unsatisfactory conditions have been corrected.
1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Exterior galvanized steel items shall not be painted unless noted otherwise.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Paint entire exposed surface of window frames and sashes.
 - 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide enough difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

- A. All items to be painted shall receive a minimum of primer and two coats of paint, typical.
- B. Steel and Iron Substrates:
 - 1. Water-Based Light Industrial Coating System MPI EXT 5.1N:

- a. Prime Coat: Primer, epoxy, anti-corrosive MPI #101.
- b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, exterior, water based, semi-gloss (MPI Gloss Level 5), MPI #163.

C. Galvanized-Metal Substrates:

- 1. Latex System:
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

D. Concrete Substrates, Nontraffic Surfaces:

- 1. Latex System MPI EXT 3.1A:
 - a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, flat (MPI Gloss Level 1), MPI #10.

E. Portland Cement Plaster Substrates (Semi-Gloss, Acrylic Paint):

- 1. Latex System:
 - a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
 - b. Intermediate Coat: Latex, exterior, matching topcoat.
 - c. Topcoat: Latex, exterior, (MPI Gloss Level 5), MPI #10.

END OF SECTION 09 91 13

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on interior substrates.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.

3. Label each coat of each Sample.
 4. Label each Sample for location and application area.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 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.

1.7 FIELD 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Dunn-Edwards Corporation (a Nippon Paint Holdings Co. Ltd. company).
 2. Frazee; Sherwin-Williams Company (The).
 3. PPG Industries.
 4. Vista Paint Corporation.
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include but are not limited to products listed in the finish schedule on drawings.

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Dry-Fog Coatings: 400 g/L.
 - 4. Primers, Sealers, and Undercoaters: 200 g/L.
 - 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 - 7. Pretreatment Wash Primers: 420 g/L.
 - 8. Shellacs, Clear: 730 g/L.
 - 9. Shellacs, Pigmented: 550 g/L.
- D. Colors: As indicated in the finish schedule on drawings.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

INTERIOR PAINTING

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3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat but provide enough difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or another paintable jacket material.
 - 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or another paintable jacket material.
 - h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Traffic Surfaces:
 1. Water-Based Concrete Floor Sealer System MPI INT 3.2G:
 - a. First Coat: Sealer, water based, for concrete floors, matching topcoat.
 - b. Topcoat: Sealer, water based, for concrete floors, MPI #99.
- B. Steel Substrates:
 1. Institutional Low-Odor/VOC Latex System MPI INT 5.1S:
 - a. Prime Coat: Primer, rust inhibitive, water based MPI #107.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

C. Galvanized-Metal Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 5.3N:
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.

D. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System MPI INT 9.2M:
 - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #50.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - a. Topcoat (ceiling, typ.): Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143.
 - b. Topcoat (walls): Latex, interior, institutional low odor/VOC, eggshell (MPI Gloss Level 5), MPI #147.

END OF SECTION 09 91 23

SECTION 09 97 37 – WHITEBOARD WALLCOVERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: This Section specifies field-applied dry erase coatings including surface preparation and primer.
- B. Adhesive Backed Dry Erase Wallcovering.
- C. Accessories.
- D. Related Sections:
 - 1. Division 26 51 00 Interior Lighting.
 - 2. Division 09 29 00 Gypsum Board: Wall substrate.
 - 3. Division 09 91 23 Interior Painting: Priming for vinyl wall coverings.
 - 4. Division 09 72 16 Flexible Vinyl Wall Coverings.
 - 5. Division 10 11 00 Visual Display Surfaces: Chalk and markerboards.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, preparation instructions, storage and handling requirements, installation methods, and recommendations.
- B. Maintenance Instructions: Provide precautions against cleaning materials and methods that may be detrimental to finish and performance.
- C. Samples: Submit verification sample of specified color on manufacturer's standard sample card.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 3 years manufacturing dry erase coatings.
- B. Mock-ups: Prepare mock-ups for Architect's review and to establish requirements for substrate finish and final coating application, texture and color.
 - 1. Install dry erase coatings mock-up in area designated by Architect.
 - 2. Correct areas, modify method of application/installation, or adjust finish texture as directed by Architect to comply with specified requirements.
 - 3. Maintain mock-ups accessible to serve as a standard of quality for this Section.

- a. Accepted mock-ups may remain in place.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original factory wrappings and containers, clearly labeled with manufacturer, product name, and fire hazard classification
- B. Store materials in original undamaged packages and containers inside a well - ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity. Store at temperatures above 40 degrees F. Do not allow product to freeze.

1.5 PROJECT CONDITIONS

- A. Maintain ambient temperature not less than 50 deg F minimum and 85 deg F maximum 72 hours prior to beginning of installation.
 - 1. Do not install dry erase coatings unless substrate temperature is above 60 degrees F.
 - 2. Do not install dry erase coatings until the space is enclosed and weatherproof.
 - 3. Do not install dry erase coatings until temperature is stabilized and permanent lighting is in place.
- B. Provide not less than 80-foot-candles per square foot lighting level measured mid-height at substrate surfaces.

1.6 WARRANTY

- A. Submit manufacturer's limited ten-year written warranty against manufacturing defects.

PART 2 - PRODUCTS

- A. Manufacturer:
 - 1. Wallcoverings: Walltalkers Wallcoverings manufactured by Koroseal Interior Products, LLC., Fairlawn, Ohio, or approved equal.
- B. Substitutions: Refer to Division 01 Section "Substitution Procedures."

2.2 MATERIALS

- A. Walltalkers Just-Rite: Woven backed, white pigmented vinyl capped with semi-gloss, dry erase film.
 - 1. JR48: 47/48 inch width (1.19/1.22m), scrim backing.

2.3 ACCESSORIES

- A. Adhesives: Heavy-duty clear or clay based premixed vinyl adhesive.

- B. Substrate Primer/Sealer: White pigmented acrylic base primer/sealer specifically formulated for use with vinyl wallcoverings.
- C. Presentation Starter Kit: Provide one Walltalkers starter kit containing eight dry erase markers, one eraser, two dry erase cleaning cloths, one empty bottle for water, and one 8 ounce (.23kg) bottle liquid surface cleaning solution for each room installed with dry erase wallcovering.
 - 1. RK1RSK2: Regular starter kit with standard dry erase markers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions in which dry erase coatings will be installed.
 - 1. Complete finishing operations, including painting, before beginning installation of dry erase coatings.
 - 2. Wall surfaces to receive dry erase coatings shall be dry and free from dirt, grease, loose paint, and scale.
 - 3. Do not proceed with installations until unsatisfactory conditions have been corrected.
- B. Examine substrates and installation conditions to ensure surface conditions meet or exceed a Level 4 finish, per GA-214-M-97: Recommended Levels of Gypsum Board Finish, and permanent lighting should be installed and operational.
- C. Test substrate with suitable moisture meter and verify that moisture content does not exceed four percent.
- D. Verify substrate surface is clean, dry, smooth, structurally sound, and free from surface defects and imperfections that would show through the finished surface.
- E. Evaluate all painted surfaces for the possibility of pigment bleed-through.
- F. Notify the contractor and architect in writing of any conditions detrimental to the proper and timely completion of the installation.
- G. Beginning of installation means acceptance of surface conditions.

3.2 SURFACE PREPARATION

- A. Remove hardware, accessories, plates and similar items to allow dry erase coatings to be installed.
- B. Repair damaged areas by filling voids with spackle. Sand smooth repaired or textured surfaces. Scuff glossy and non-porous surfaces using medium grit sandpaper. Paint product is a high gloss coating; imperfections and visible seams will telegraph.
 - 1. Gypsum Board Surface: Provide Level 4 finish per ASTM C840 and GA-214. Recess nails and screws. Repair irregular tape joints, sand and remove dust.

- C. Previously Painted Surface: To have opaque White or Black applied, remove loose paint or scale. Sand surface of enamel or gloss paint. Remove dust with tack cloth or denatured alcohol prior to priming.
- D. Prime: Follow manufacturer's application, dry time, and recoat instructions prior to proceeding.
 - 1. Metal pigments will settle to bottom – hand stir thoroughly for 3-5 minutes prior to application to ensure smooth, even consistency. You know your paint is ready when the color is a consistent gray
 - 2. Changing color of the surface: Prime surface until the color of the existing surface does not show through.
 - 3. Covering stained surface: Prime surface until undesired marks and stains do not show through.
- E. Clean: Wipe surface with a clean, damp cloth to remove dust and environmental debris. Allow surface to completely dry.
- F. Ventilate area thoroughly to aid in curing process and to dissipate mild odor. Allow a high percentage of outside air into current ventilation.

3.3 INSTALLATION (SELF-ADHESIVE BACKING)

- A. Apply Walltalkers adhesive backed dry erase wallcovering only on surfaces impervious to moisture such as chalkboards, marker boards, glass, high-pressure laminates, or similar.
- B. Acclimate wallcovering in the area of installation a minimum of twenty-four hours before installation.
- C. Examine all materials for color, quantity, and quality as specified for the correct location prior to cutting.
- D. Read and follow the instructions in the manufacturer's installation sheet contained in each roll of the dry erase wallcovering.
- E. Do not crease or bend the wallcovering when handling.
- F. Mix dampening solution by using one half to one capful of mild detergent to 1 gallon (1.81kg) clean water. Dampening solution is used in positioning the material and allows for the removal of air bubbles.
- G. Use a pump spray bottle to apply the dampening solution to the the surface.
- H. Slowly remove release liner and smooth wall covering to the hanging surface using a wallcovering smoother wrapped with a soft cloth from the middle to the outside edge to remove air bubbles.
- I. Stop installation of material that is questionable in appearance and notify the manufacturer's representative for an inspection.

3.4 CLEANING AND MAINTENANCE

- A. Regular erasing and cleaning should be done with a standard dry erase eraser or a dry microfiber towel. For more thorough cleaning, a damp microfiber towel may be used or IdeaPaint Cleaner. If damaged, the original surface shall be deglossed by sanding surface and priming before recoating.
- B. Upon completion of installation, remove all exposed adhesive immediately using a soft cloth and a warm, mild soap solution and rinse thoroughly with water and dry with clean towel prior to using.
- C. Upon completion of the work, remove surplus materials, rubbish, and debris resulting from the wallcovering installation. Leave areas in neat, clean, and orderly condition.

3.5 PROTECTION

- A. Protect installed product and finished surfaces from damage during construction.

END OF SECTION 09 97 37

SECTION 10 11 00 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Porcelain Enamel Steel Markerboards and Chalkboards
 - 2. Porcelain Sliding Units

1.3 REFERENCE STANDARDS

- A. American Society for Testing Materials
 - 1. ASTM E84 Standard Test Method for Surface Burning Characteristics for Building Materials
 - 2. ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wires, Profiles and Tubes
- B. Porcelain Enamel Institute
 - 1. PEI-1002 Manual and Performance Specifications for Porcelain Enamel Writing Surfaces
- C. GREENGUARD Certification from UL Environment
 - 1. Meets GREENGUARD Gold Standard for Chemical Emissions for Building Materials, Finishes and Furnishings

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
- B. Shop Drawings: For visual display units.
 - 1. Include plans, elevations, sections, details, and attachment to other work.
 - 2. Show locations of panel joints.
 - 3. Include sections of typical trim members.
- C. Samples: For each type of visual display unit indicated.

1. Visual Display Panel: Not less than 8-1/2 by 11 inches, with facing, core, and backing indicated for final Work. Include one panel for each type, color, and texture required.
2. Trim: 6-inch-long sections of each trim profile.
3. Accessories: Full-size Sample of each type of accessory.

D. Product Schedule: For visual display units.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For visual display units to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Manufacturer shall be a firm engaged in the manufacture of visual display boards in the United States.
2. Manufacturer shall have a minimum of 5 years experience in the manufacture of visual display boards.

B. Regulatory Requirements: Conforms to applicable code for flame/smoke rating in tackboards in accordance with ASTM E84.

C. Product Certifications: Provide GREENGUARD Gold certificate for markerboards, as applicable.

D. Operation and Maintenance: Include data on regular cleaning, stain removal, and precautions.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

B. Schedule delivery of visual display boards with spaces sufficiently complete so that visual display boards can be installed upon delivery.

C. Store products in manufacturer's unopened packaging until ready for installation.

D. Store materials protected from exposure to harmful weather conditions and at temperatures and humidity conditions recommended by manufacturer.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.
 - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.9 WARRANTY

- A. Special Warranty for projection marker boards: Manufacturer agrees to repair or replace marker boards that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 5 years.
- B. Special Warranty for graphic marker boards: Manufacturer agrees to repair or replace marker boards that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing 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: 450 or less.

2.3 VISUAL DISPLAY BOARD ASSEMBLY AND VERTICAL SLIDING WALLS

- A. Visual Display Board Manufacturer: Claridge Products and Equipment, Inc., Harrison, Arkansas 72601; Toll Free: 800-434-4610; Telephone: 870-743-2200; Fax: 870-743-1908; E-mail: claridge@claridgeproducts.com; website: www.claridgeproducts.com; or approved equal.

2.4 MATERIALS FOR MARKERBOARD

- A. Writing Surface Face Sheet – Manufactured in accordance with Porcelain Enamel Institute's specification.
 - 1. Shall be enameling grade cold rolled steel manufactured from a minimum of 30 percent post-consumer and post-industrial waste.
 - 2. Enameling grade steel shall be coated with LCS³ Porcelain Enamel by Claridge Products and Equipment.

- a. 3-Coat process shall include:
 - 1) Bottom Ground Coat – 1.5 to 2.2 mils
 - 2) Top Ground Coat – 2.0 to 2.8 mils
 - 3) Top Cover (Color) Coat – 3.0 to 4.0 mils
 3. Firing Temperature: Enamel shall be fired at lowest possible temperatures to reduce steel and porcelain stresses and achieve superior enamel and hardness.
 4. Color: As selected by architect from manufacturer's standards. Color charts furnished on request. NOTE: LCS³ No. 100 White can be used as a projection surface.
- B. Writing Surface Core
1. 7/16" Medium Density Fiberboard (MDF) composed of approximately 90% post- industrial waste.
- C. Writing Surface Backing
1. Steel Back
- D. Factory Framed Markerboards and Chalkboards
1. Face Sheet: Specify LCS³ porcelain enamel steel Markerboard.
 2. Core Material: 7/16" MDF
 3. Backing: Steel Back
 4. Series: Series 3
 5. Typical Arrangement: as indicated on drawings.
 6. Panel Size: as indicated on drawings.
 7. Color: White.

2.4 ALUMINUM TRIM

- A. Trim shall be 6063 alloy grade aluminum with T5 tempering in accordance with ASTM B221, and shall have 201-R1 satin anodize finish. (Color Anodize and Powder Coat finishes optional)
1. Factory Built Trim
 - a. Series: 3
- B. Accessories:
1. Marker Tray/Chalktrough
 - a. Standard continuous, solid, blade-type aluminum tray with ribbed section and injection molded end closures at bottom of each markerboard or chalkboard

2.5 PORCELAIN SLIDING WALLS

- A. Porcelain Sliding Walls
1. Series: two-track
 - a. Sliding Panels and/or Back Panel - Writing surface:
 - 1) Porcelain enamel steel Markerboard
 - 2) Porcelain enamel steel Chalkboard
 2. Sizes: as indicated on drawings.
 3. Typical Arrangements: as indicated on drawings.
- B. Metal Trim and Accessories: Provide aluminum extrusions as manufactured by Claridge Products and Equipment, Inc. Frame and exposed members shall be heavy gauge extruded aluminum and shall meet or exceed ASTM B221 Alloy Standards.
1. Finish: Etched and anodized satin finish.

- C. Colors: As selected from manufacturer's standard colors. Color charts furnished on request.
- D. Adhesive: As recommended by manufacturer.

2.6 FABRICATION

- A. Shop assembly: Provide Horizontal Sliding Units with all corners reinforced with angles to strengthen frame. Nylon ball bearing rollers at top of unit and nylon guide rollers at bottom of unit to be of sufficient size and number to eliminate vibration and provide smooth and quiet operation of the panels
 - 1. Porcelain Markerboard or Chalkboard:
 - a. Sliding Panels:
 - 1) Face Sheet: Porcelain Enamel Steel
 - 2) Core: 1/2" honeycomb
 - 3) Backing: steel
 - b. Back Panels:
 - 1) Face Sheet: Porcelain Enamel Steel
 - 2) Core: 7/16" MDF (Medium Density Fiberboard)
 - 3) Backing: Moisture Barrier Back

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 of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Verify before installation that interior moisture and temperature approximate normal occupied conditions and HVAC is in place and working.
- E. Verify that wall surfaces are true and plumb and are prepared and ready to receive boards.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

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- D. Prime wall surfaces indicated to receive visual display units and direct-applied floor-to-ceiling visual display assemblies and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.

3.3 INSTALLATION

- 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.
- B. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.
- C. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings.
- D. Deliver factory built units completely assembled and of dimensions shown in details and in accordance with manufacturer's shop drawings as approved by the architect.
- E. Follow manufacturer's instructions for storage and handling of units before installation.
- F. Do not install boards on damp walls or in damp and humid weather without heat in the building.
- G. Install level and plumb, keeping perimeter trim straight in accordance with manufacturer's recommendations.

3.4 CLEANING AND PROTECTION

- A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 10 11 00

SECTION 10 14 00 – SIGNAGE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Room identification signs.
- B. Building identification signs.
- C. Interior directional and informational signs.
- D. Traffic Signs
- E. Dimensional Lettering

1.2 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. California Building Code (CBC) 2019- Chapter 11B.

1.3 REGULATORY REQUIREMENTS

- A. Raised characters shall comply with CBC Section 11B-703.2:
 - 1. Depth: It shall be 1/32-inch (0.8 mm) minimum above their background and shall be sans serif uppercase and be duplicated in Braille.
 - 2. Height: It shall be 5/8-inch (15.9 mm) minimum and 2 inches (51 mm) maximum based on the height of the uppercase letter 'I'. CBC Section 11B-703.2.5
 - 3. Finish and contrast: Characters and their background shall have a non-glare finish. Characters shall contrast with their background with either light characters on a dark background or dark characters on a light background. CBC Section 11B-703.5.1
 - 4. Proportions: It shall be selected from fonts where the width of the uppercase letter 'O' is 60% minimum and 100% maximum of the height of the uppercase letter 'I'. Stroke thickness of the uppercase letter 'I' shall be 15% maximum of the height of the character. CBC Sections 11B-703.2.4 and 11B-703.2.6
 - 5. Character Spacing: Spacing between individual raised characters shall comply with CBC Section 11B-703.2.7 and 11B-703.2.8

6. Format: Text shall be in a horizontal format. CBC Section 11B-703.2.9
7. Braille: It shall be contracted (Grade 2) and shall comply with CBC Section 11B-703.3 and 11B-703.4. Braille dots shall have a domed or rounded shape and shall comply with CBC Table and Figure 11B-703.3.1.
8. Mounting Height: Tactile characters on signs shall be located 48 inches minimum to the baseline of the lowest Braille cells and 60 inches maximum to the baseline of the highest line of raised characters above the finish floor or ground surface. CBC Section and Figure 11B-703.4.1.
9. Mounting location: A tactile sign shall be located per CBC Section and Figure 11B-703.4.2 as follows:
 - a. Alongside a single door at the latch side.
 - b. On the inactive leaf at double door with one active leaf.
 - c. To the right of the right-hand door at double doors with two active leaves.
 - d. On the nearest adjacent wall where there is no wall space at the latch side of a single door or at the right side of double doors with two active leaves.
 - e. So that a clear floor space of 18 by 18 inches minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45-degree open position.
- B. Visual characters shall comply with CBC Section 11B-703.5 and shall be 40 inches minimum above finish floor or ground.
- C. Pictograms shall comply with CBC Section 11B-703.6.
- D. Symbols of accessibility shall comply with CBC Section 11B-703.7
- E. Variable message signs shall comply with CBC Section 11B-703.8

1.4 SUBMITTALS

- A. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- B. Signage Schedule: Provide information enough to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule.
 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 3. Submit for approval by Owner through Architect prior to fabrication.
- C. Samples: Submit two samples of each type of sign, of size like that required for project, illustrating sign style, font, and method of attachment.

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- D. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- E. Verification Samples: Submit samples showing colors specified. Printed material will not be accepted in lieu of physical samples.
- F. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- G. Maintenance instructions.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.7 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Restroom Signs:
 - 1. ASI Sign Systems <https://asisignage.com>
 - 2. Mohawk Sign Systems, Inc: www.mohawksign.com.
 - 3. Vomar <http://vomarproducts.com/>
- B. Room and Door Signs:
 - 1. Architectural Sign Identity, www.architecturalsignidentity.com.
 - 2. ASI - Modulex, www.asimodullex.com.

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3. Best Manufacturing, www.bestsigns.com.
4. Bravo Sign and Design, www.bravosign.com.
5. CA Signs, www.casigns.com.
6. Mohawk Sign Systems, www.mohawksign.com.
7. Neiman and Company, www.neimanandco.com.
8. Signs and Lucite Products, Inc., www.signscalifornia.com
9. Southwell Company, www.southwellco.com.
10. Vomar Products, Inc., www.vomarproducts.com.

C. Metal and Traffic Signs:

1. Four S Company, (877) 597-1288.
2. Signs and Lucite Products, Inc., www.signscalifornia.com
3. Traffic Control Service Inc., www.trafficmanagement.com.

D. Dimensional Lettering

1. ASI – Modulex, www.asimodulex.com
2. A.R.K. Ramos, Oklahoma City, OK
3. Mohawk Sign Systems, www.mohawksign.com

2.2 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

1. Refer to the drawings for additional requirements.

2.3 SIGN AND SYMBOL TYPES

- A. Refer to drawings for signage types, fonts, colors and mounting details.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
1. Sign Type: Photopolymer face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet.

2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.
 3. Character Height: As indicated on drawings.
 4. Sign Height: As indicated on drawings.
- C. Interior Directional and Informational Signs:
1. Sign Type: Same as room and door signs.
 2. Sizes: As indicated on the drawings.
 3. Wording of signs is scheduled on the drawings.
- D. Exterior Signs: Exterior signs mounted on posts or walls to be 0.125-inch aluminum panel
- a. Finish: Baked enamel finish
 - b. Mounted to 3-inch galvanized steel post set in 36-inch by 12-inch, 2500 PSI concrete footing.
 - c. Obtain tow away phone numbers from District.
- E. Dimensional Letters: Precision cut metal letters; furnish ASI-Modulex, LPG Series or equal. Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:
1. Metal: Aluminum casting.
 2. Finish: Brushed, satin.
 3. Size, Fonts and Mounting: As indicated on drawings.
- 2.4 ACCESSORIES
- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
 - B. Tape Adhesive: Double sided tape, permanent adhesive.
 - C. Blank panel of matching color and size where signs are mounted on glazing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. All signage to be mechanically fastened. Double sided tape may only be used as reinforcement.
- C. Install dimensional letter signage out of the reach of students.
- D. Install neatly, with horizontal edges level.
- E. Locate signs and symbols where indicated:
 - 1. Room and Door Signs: Locate as indicated on drawings.
 - 2. If no location is indicated obtain Owner's instructions.
- F. Protect from damage until Substantial Completion; repair or replace damage items.

END OF SECTION 10 14 00

SECTION 10 21 13.19 - PLASTIC 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. Section Includes:
 - 1. Solid-plastic toilet compartments configured as toilet enclosures and urinal screens.
- B. Related Requirements:
 - 1. Section 10 28 00 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.
- B. Shop Drawings: For toilet compartments.
 - 1. Include plans, elevations, sections, details, and attachment details.
 - 2. Show locations of cutouts for compartment-mounted toilet accessories.
 - 3. Show locations of centerlines of toilet fixtures.
 - 4. Show locations of floor drains.
 - 5. Show overhead support or bracing locations.
- C. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
 - 2. Each type of hardware and accessory.
- D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents and source.
 - 1. Door Hinges: One hinge(s) with associated fasteners.
 - 2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
 - 3. Door Bumper: One bumper(s) with associated fasteners.
 - 4. Door Pull: One door pull(s) with associated fasteners.
 - 5. Fasteners: Ten fasteners of each size and type.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing 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: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the California Building Code for toilet compartments designated as accessible.
 - 1. Wheelchair accessible compartment shall comply with Section 11B-604.8.1.
 - 2. Door and door hardware for accessible compartments shall be self-closing and shall comply with CBC Section 11B-404 except that if the approach is to the latch side of an ambulatory compartment door, clearance between the door side of the compartment and any obstruction shall be 44" minimum. CBC Figure 11b-604.8.2.
 - 3. A door pull complying with CBC Section 11B-404.2.7 shall be placed on both sides of the door near the latch.
 - 4. Toe clearance for at least one side portion of a wheelchair accessible compartment shall comply with CBC Section and Figure 11B-604.8.1.4. It shall be 9 inches high minimum above the finish floor and 6 inches deep minimum beyond the compartment side face of the partition, exclusive of partition support members. It shall be 12 inches high minimum

PLASTIC TOILET COMPARTMENTS

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above the finish floor for children's use. Partition components at toe clearance shall be smooth without sharp edges or abrasive surfaces. Toe clearance at the side partition is not required in a compartment greater than 66 inches wide.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Accurate Partitions Corp.; ASI Group (basis of design).
 - 2. Bradley Corporation.
 - 3. Marlite.
 - 4. Scranton Products.
- B. Toilet-Enclosure Style: Overhead braced.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material. Partitions to be fabricated from polymer resins compounded under high pressure, forming a single component which is waterproof, nonabsorbent and has a self-lubricating surface that resists marks from pens, pencils, markers and other writing instruments. All plastic components shall be covered with a protective plastic coating.
 - 1. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum or stainless-steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
 - 2. Doors and panels to be 55 inch high and mounted 14 inches above finished floor
 - 3. Color and Pattern: Black Paisley
- E. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; 3 inch high polymer shoe with stainless steel tamper resistant torx head sex bolt.
 - 1. Polymer Color and Pattern: As selected by Architect from manufacturer's full range.
- F. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard design; satin stainless steel.

2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.
 - 1. Hinges: heavy-duty extruded aluminum wrap-around hinges through-bolted to pilasters and doors with stainless steel tamper resistant Torx head sex bolts.
 - 2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply

- with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts. Install at 48" max. height in accessible stalls.
 4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors. Mount with through-bolts.
 5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.
- B. Overhead Bracing: Heavy-duty extruded aluminum (6463 - T5 alloy) with anti-grip design. The head rail is to have a clear anodized finish. Fasten to head rail bracket with stainless steel tamper resistant torx head sex bolts and fasten to the pilasters with stainless steel tamper resistant torx head screws.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: ASTM B 221.
- C. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- D. Stainless-Steel Castings: ASTM A 743/A 743M.
- E. Colors: To match existing partitions or as selected by Architect from MFR's full range.

2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, in-swinging doors for standard toilet compartments and 36-inch- wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch.
 - b. Panels and Walls: 1 inch.
 - 2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
 - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer 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. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10 21 13.19

SECTION 10 21 23 - CUBICLE CURTAINS AND TRACK

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. Cubicle-curtain tracks and carriers.
 - 2. Cubicle curtains.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for supplementary wood framing and blocking for mounting items requiring anchorage.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For each type of curtain fabric indicated, include durability, laundry temperature limits, fade resistance, applied curtain treatments, and fire-test-response characteristics.
- B. Shop Drawings: For curtains and tracks.
 - 1. Show layout and types of cubicles, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.
 - 2. Include details of blocking for track support.
- C. Samples: For each exposed product and for each color and texture specified, 10 inches in size.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For curtains, tracks, and hardware to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- 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. Curtain Carriers and Track End Caps: Full-size units equal to 3 percent of amount installed for each size indicated, but no fewer than 10 units.
 - 2. Curtains: Full-size units equal to 10 percent of amount installed for each size indicated, but no fewer than two units.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Cubicle Curtains: Provide curtain fabrics with the following characteristics:
 - 1. Laundering: Launderable to a water temperature of not less than 160 deg F.
 - 2. Flame Resistance: Provide fabrics identical to those that have passed NFPA 701 when tested by a qualified testing agency acceptable to authorities having jurisdiction.
 - a. Identify fabrics with appropriate markings of a qualified testing agency.

2.2 CUBICLE-CURTAIN SUPPORT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. A. R. Nelson Co.
 - 2. Construction Specialties, Inc.
 - 3. Cubicle Curtain Factory, Inc.
 - 4. Inpro Corporation (basis of design).
- B. Extruded-Aluminum Curtain Track: Not less than 5/8 inch wide by 1/2 inch high.
 - 1. Track Minimum Wall Thickness: Manufacturer's standard.
 - 2. Curved Track: Factory-fabricated, 12-inch-radius bends.
 - 3. Finish: Clear anodized.
- C. Curtain Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.
- D. Curtain Roller Carriers: Two nylon rollers and nylon axle with chrome-plated steel, nylon or aluminum hook.
- E. Exposed Fasteners: Stainless steel.
- F. Concealed Fasteners: Hot-dip galvanized or Stainless steel.

2.3 CURTAINS (CT-1)

- A. Basis-of-Design: As indicated in Interior Finish Schedule, or approved equal.
- B. Fabric: Curtain manufacturer's standard, 100 percent polyester; inherently and permanently flame resistant, stain resistant, and antimicrobial.
 - 1. Color: As indicated.
- C. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches o.c.; machined into top hem.
- D. Mesh Top: Not less than 20-inch-high mesh top.
 - 1. Mesh: No. 50 nylon mesh.
- E. Snap Attachments: Provide manufacturer's standard nickel-plated brass snap attachments for modular panels.
- F. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.

2.4 CURTAIN FABRICATION

- A. Continuous Curtain Panels:
 - 1. Width: Equal to track length from which curtain is hung plus 10 percent of added fullness, but not less than 12 inches of added fullness.
 - 2. Length: Equal to floor-to-ceiling height, minus depth of track and carrier at top, and minus clearance above the finished floor of 12 inches, unless indicated otherwise on Drawings.
 - 3. Top Hem: Not less than 1 inch and not more than 1-1/2 inches wide, triple thickness, reinforced with integral web, and double lockstitched.
 - 4. Mesh Top: Top hem of mesh not less than 1 inch and not more than 1-1/2 inches wide, triple thickness, reinforced with integral web, and double lockstitched. Double lockstitch bottom of mesh directly to 1/2-inch triple thickness, top hem of curtain fabric.
 - 5. Vertical Seams: Not less than 1/2 inch wide, double turned and double stitched.

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

3.2 INSTALLATION

- A. Install tracks level and plumb, according to manufacturer's written instructions.

CUBICLE CURTAINS AND TRACK

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- B. Install curtain track secure and rigid, true to ceiling line.
- C. Install end cap, stop device, splices and curved track sections.
- D. Secure track to suspended ceiling system.
- E. Protect units so they will be operable and undamaged at completion of project.
- F. Repair or replace damaged or defective units.

END OF SECTION 10 21 23

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Corner guards.

- B. Related Requirements:

- 1. Section 087100 "Door Hardware" for metal protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.3 ACTION SUBMITTALS

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

- 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: For each type of wall and door protection showing locations and extent.

- 1. Include plans, elevations, sections, and attachment details.

- C. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:

- 1. Corner Guards: 12 inches long. Include example top caps.

- D. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

- 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
 - 2. Keep plastic materials out of direct sunlight.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door-protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
 - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing 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: 450 or less.

2.3 CORNER GUARDS

- A. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Construction Specialties, Inc.

- b. Inpro Corporation (basis of design).
 - c. Korogard Wall Protection Systems; a division of RJF International Corporation.
- 2. Material: Stainless-steel sheet, Type 304.
 - a. Thickness: Minimum 0.0625 inch, unless indicated otherwise on drawings.
 - b. Finish: Directional satin, No. 4.
- 3. Wing Size: As indicated on drawings.
- 4. Corner Radius: 1/8 inch.
- 5. Mounting: Adhesive; unless fastener mounting is indicated on drawings.

2.4 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- C. Adhesive: As recommended by protection product manufacturer.
 - 1. Verify adhesives have a VOC content of 70 g/L or less.
 - 2. Verify adhesive complies 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."

2.5 FABRICATION

- A. Fabricate door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

- A. Protect 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of the Work.
- B. Examine walls to which door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 1. For door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 10 26 00

SECTION 10 28 00 – TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Warm-air dryers.
 - 3. Under lavatory guards.
 - 4. Custodial accessories.

1.3 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Include electrical characteristics.
- B. Samples: Full size, for each exposed product and for each finish specified.
 - 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.
 - 2. Identify accessories using designations indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

1.7 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

- A. Owner-Furnished Materials (Installed by contractor):
 - 1. Paper towel dispensers
 - 2. Soap dispensers
 - 3. Toilet paper dispensers (except at accessible toilets/stalls).

2.2 PERFORMANCE REQUIREMENTS

- A. California Building Code:
 - 1. Elements of sanitary facilities shall be mounted at location in compliance with CBC Sections 11B-602 through 11B-612
 - 2. Grab bars in toilet facilities and bathing facilities shall comply with CBC Section 11B-609. Grab bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive elements and shall have rounded edges. The space around the grab bars shall be as follows:
 - a. 1-1/2 inch between the grab bar and wall.
 - b. 1-1/2-inch minimum between the grab bar and projecting objects below and at the ends.
 - c. 12 inch minimum between the grab bar and projecting objects above.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.

2.3 PUBLIC-USE WASHROOM ACCESSORIES

- A. Manufacturers:
 - 1. Bobrick (Basis-of-Design)
 - 2. Approved Equal
- B. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
- C. Toilet Tissue (Roll) Dispenser (accessible stall):
 - 1. Basis-of-Design: Bobrick B-3888
 - 2. Double roll, recessed, continuous flow, stainless steel unit with tumbler lock.
- D. Toilet Seat Cover Dispenser:
 - 1. Basis-of-Design: Bobrick B221
 - 2. Satin-finish stainless steel. Dispense 250 single- or half-fold toilet seat covers or one box.
- E. Combination Towel (Folded) Dispenser/Waste Receptacle:
 - 1. Basis-of-Design: Bobrick B369
 - 2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
 - 3. Mounting: Recessed.
 - 4. Minimum Towel-Dispenser Capacity: 350 C-fold or 475 multifold paper towels.
 - 5. Minimum Waste-Receptacle Capacity: 2 gal..
 - 6. Material and Finish: Stainless steel, No. 4 finish (satin).
- F. Grab Bar:
 - 1. Basis-of-Design: Bobrick B05806 series.
 - 2. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05-inch wall thickness, exposed flange mounting, 1-1/2-inch clearance between wall and inside of grab bar.
 - c. Length and Configuration: As indicated on drawings.
- G. Sanitary-Napkin Disposal Unit:
 - 1. Basis-of-Design: Bobrick B-254
 - 2. Stainless steel, surface-mounted or recessed as indicated, self-closing door, locking bottom panel with full-length stainless-steel piano-type hinge, removable receptacle.
- H. Mirror Unit:
 - 1. Basis-of-Design: Bobrick B-165 series.
 - 2. One-piece roll-formed, type 304 stainless steel angle framed mirror with continuous stiffener on all sides. No. 1 quality, 1/4 inch select float glass mirror with type 430 stainless steel channel frame with bright polished finish.
 - 3. Size: As indicated on Drawings.
- I. Coat Hook:
 - 1. Basis-of-Design: Bobrick B-212
 - 2. Material and Finish: Stainless steel, No. 4 finish (satin).

2.4 WARM-AIR DRYERS

- A. Source Limitations: Obtain warm-air dryers from single source from single manufacturer.
- B. Warm-Air Dryer:
 - 1. Approved Manufactures:
 - a. Pinnacle Recessed Mount- Model PDC-R10.
 - b. World Dryer Corporation – VERDEdri #Q973A.
 - 2. Description: Standard-speed, vandal resistant, ADA compliant warm-air hand dryer.
 - 3. Mounting: Recessed or Surface depending on application – refer to drawings.
 - 4. Operation: Electronic sensor activated with timed power cut-off switch.
 - 5. Cover Material and Finish: Stainless steel, No. 4 finish (satin).
 - 6. Electrical Requirements: 11.5 amps, 1370 Watts at 120 Vac Nominal.

2.5 UNDERLAVATORY GUARDS

- A. Under lavatory Guard:
 - 1. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
 - 2. Material and Finish: Antimicrobial, molded plastic, white.

2.6 CUSTODIAL ACCESSORIES

- A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.
- B. Utility Shelf:
 - 1. Description: With exposed edges turned down not less than 1/2 inch and supported by two triangular brackets welded to shelf underside.
 - 2. Size: 16 inches long by 6 inches deep.
 - 3. Material and Finish: Not less than nominal 0.05-inch-thick stainless steel, No. 4 finish (satin).
- C. Mop and Broom Holder:
 - 1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
 - 2. Length: 36 inches.
 - 3. Hooks: Four.
 - 4. Mop/Broom Holders: Three, 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.

2.7 MATERIALS

- A. Stainless Steel: ASTM A666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.
- C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- F. 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.
- G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.8 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 ASTM F446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.

TOILET AND BATH ACCESSORIES

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- C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 10 28 00

SECTION 10 44 13 - FIRE PROTECTION 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. Fire-protection cabinets for the following:
 - a. Portable fire extinguisher.
- B. Related Requirements:
 - 1. Section 10 44 16 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semi recessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
 - 2. Show location of knockouts for hose valves.
- B. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semi recessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

FIRE PROTECTION CABINETS

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire Extinguisher Cabinets: Comply with California Building Code Sections 11B-307, 11B-308, 11B-309 and 11B-403.
- B. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.
- 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.

2.3 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
- B. Cabinet Construction: Nonrated, fire rated (to match partition fire rating).
- C. Cabinet Material: Cold-rolled steel sheet.
 - 1. Shelf: Same metal and finish as cabinet.
- D. Semi recessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
 - 1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.
 - 2. Projection from wall surface must meet ADA and California Building Code requirements.
- E. Cabinet Trim Material: Same material and finish as door.
- F. Door Material: Steel sheet.
- G. Door Style: Vertical duo panel with frame.
- H. Door Glazing: Tempered float glass (clear).
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide recessed door pull and friction latch.
 - 2. Provide manufacturer's standard hinge, permitting door to open 180 degrees.
- J. Accessories:

FIRE PROTECTION CABINETS

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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. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to location indicated on Drawings.
 - 2) Application Process: Decals or Pressure-sensitive vinyl letters.
 - 3) Lettering Color: As indicated by the Architect.
 - 4) Orientation: Vertical.

K. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
 - b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. Color: As selected by Architect from manufacturer's full range.
2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.4 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. Miter corners and grind smooth.
 3. Provide factory-drilled mounting holes.
 4. Prepare doors and frames to receive locks.
 5. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 2. Fabricate door frames of one-piece construction with edges flanged.
 3. Miter and weld perimeter door frames and grind smooth.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed and semi recessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for recessed and semi recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate 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.
 - 4. Fire-Rated Cabinets:
 - a. Install cabinet with not more than 1/16-inch tolerance between pipe OD and knockout OD. Center pipe within knockout.
 - b. Seal through penetrations with firestopping sealant as specified in Section 078413 "Penetration Firestopping."
- C. Identification:
 - 1. Apply decals or vinyl lettering at locations indicated.

FIRE PROTECTION CABINETS

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3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets 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 and mounting bracket manufacturers.
- 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 10 44 13

SECTION 10 44 16 - FIRE EXTINGUISHERS

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 portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Requirements:
 - 1. Section 10 44 13 "Fire Protection Cabinets."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.
- C. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

FIRE EXTINGUISHERS

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- a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
 - b. Faulty operation of valves or release levers.
2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire Extinguishers must comply with requirements from California Code of Regulations (CCR), Title 19, CBC Sections 11B-207, 11B-308, 11B-309, and 11B-403.
- 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 FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 1. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer; Amerex.
 2. Valves: Manufacturer's standard.
 3. Handles and Levers: Manufacturer's standard.
 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets (where shown): Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red or black baked-enamel finish.
 1. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

FIRE EXTINGUISHERS

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1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10 44 16

SECTION 10 51 13 - METAL LOCKERS

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. Heavy Duty Knocked Down Lockers.
 - 2. Locker benches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.
- B. Shop Drawings: For metal lockers.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Show locker trim and accessories.
 - 3. Include locker identification system and numbering sequence.
- C. Samples: For each color specified, in manufacturer's standard size.
- D. Product Schedule: For lockers. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. The following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:

- a. Locks.
- b. Blank identification plates.
- c. Hooks.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete masonry bases for metal lockers.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period for Welded Metal Lockers: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain metal lockers, locker benches, and accessories from single source from single locker manufacturer.
 - 1. Obtain locks from single lock manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and California Building Code.

2.3 KNOCKED-DOWN CORRIDOR LOCKERS

- A. Basis of Design Product: Lyon, LLC.

1. Penco Products
2. or approved equal.

- B. Locker Construction:

1. All locker body components made of cold rolled steel specially formed for added strength and rigidity and to ensure tight joints at fastening points.
 - a. Lockers with Doors: knock-down lockers, with legs.
2. Locker Body Construction: 24 GA Steel specially formed for added strength and rigidity and to ensure tight joints at fastening points.
 - a. Sides, Bottoms, Tops, and Shelves:
 - 1) 16 gauge steel.
 - 2) Ventilation: 3/4 inch wide by 1-1/2 inch high diamond-shaped perforations.
 - 3) Solid sides.
 - b. Backs: Solid 18 gauge steel.
3. Doors:
 - a. 16 gauge steel.
 - b. Ventilation: 3/4 inch wide by 1-1/2 inch high diamond-shaped perforations.
 - c. Solid doors.
4. Tops and bottoms with three sides formed 90 degrees, the front offset formed to be flush with horizontal frame member.
5. Shelves with four sides formed to 90 degrees, front edge having a second bend.
6. Hole spacing in locker body construction: Not exceeding 9 inches.
7. Two-tier lockers: Intermediate channel-shaped horizontal frame members attached to side frames with mortise and tenon construction, securely welded.
8. Optional factory assembly of locker bodies using rivets.

- C. Locker Doors: One piece sheet steel.

1. Multi-Point Latch Doors: Full channel formation of adequate depth to fully conceal lock bar on lock side, channel formation on hinge side, right angle formations across top and bottom, with holes for attaching number plates.
2. Single Point Latch Doors: 14 gauge door reinforced by a full height 3-1/2 inch wide, 18 gauge vertical pan welded to the top, bottom and hinge side flanges and rear of door skin on 12 inch, 15 inch and 18 inch wide doors. Provide a horizontal pan for doors wider than 18 inches.

METAL LOCKERS

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3. Single Point Latch Doors: 14 gauge door reinforced by a full 18 gauge inner pan welded to outer door skin on all four sides.
 - a. Solid outer door, solid inner pan
 - b. Diamond perforated outer, offset diamond perforated inner pan.
 - c. 3 inch or 6 inch louvered outer door, mini louvered inner pan.
 - d. Mini louvered outer, mini louvered inner pan.
 4. Doors over 15 inches Wide and 30 inches high: Provided with 3 inch wide 20 gauge full height reinforcing pan welded to inside face of door at 6 inch centers.
 5. Box Lockers (4 to 9 Tiers): Channel formations on lock and hinge sides; right angle flanges on top and bottom with friction catch door pull.
 6. Provide holes for attaching number plates.
 7. Ventilation:
 - a. Doors 20 inches or higher: 3/4 inch wide by 1-1/2 inch high diamond-shaped perforations.
 - b. All other doors: 7/16 inch wide by 15/16 inch high diamond-shaped perforations.
- D. Hinges:
1. Continuous Hinges: Continuous piano hinge for the full height of the door.
- E. Interior Equipment:
1. ADA-Compliant Lockers (Recessed Handles with Multi-Point Latch):
 - a. Double Tier Lockers: Hat shelf at maximum 48 inches off the floor for unobstructed forward and side reach.
 - b. Locker Compartment Bottom: Minimum of 15 inches off the floor, or an extra shelf placed 15 inches off the floor for unobstructed forward and side reach.
 - c. Handicapped symbol attached to door.
 - d. Hooks and rods as specified for other lockers.
 - e. At lockers designated to be accessible, the latch and lock mechanisms shall be operable with not more than 5 pounds of force and shall not require tight grasping, pinching, or twisting at the wrist.
- F. Locks: Combination padlocks.
- G. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.
- H. Continuous Zee Base: Fabricated from, manufacturer's standard thickness, but not less than 0.060-inch nominal-thickness steel sheet.
1. Height: 4 inches.
- I. Continuous Sloping Tops: Fabricated from 0.048-inch nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
- J. Finished End Panels: Minimum 16 gauge steel formed to match locker depth and height, 1 inch edge dimension; finish to match lockers; install with concealed fasteners.

- K. Front Fillers: 20 gauge steel formed in an angle shape, with 20 gauge slip joint angles formed in an angle shape with double bend on one leg forming a pocket to provide adjustable mating with angle filler.
 - 1. Attachment by means of concealed fasteners.
 - 2. Finish to match lockers.

L. Materials:

- 1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

M. Finish: Baked enamel or powder coat.

- 1. Color: As selected from manufactures full line.

2.4 LOCKS

- A. Combination Padlock: Provided by Owner.

2.5 LOCKER BENCHES

- A. Provide bench units with overall assembly height of 17-1/2 inches.

- B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.

- 1. Size: Minimum 12 inches wide by 1-1/4 inches thick by 48 inches long except provide 24-inch- wide tops where accessible benches are indicated.
- 2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.

- C. Fixed-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:

- 1. Tubular Steel: 1-1/4-inch- diameter steel tubing, with 0.1265-inch- thick steel flanges welded at top and base; with baked-enamel finish; anchored with exposed fasteners.

D. Materials:

- 1. Steel Tube: ASTM A500/A500M, cold rolled.

2.6 FABRICATION

- A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

- 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
- 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

METAL LOCKERS

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- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.
- C. Equipment: Provide each locker with an identification plate and the following equipment:
 - 1. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
- A. Knocked-Down Construction: Fabricate metal lockers using nuts, bolts, screws, or rivets for nominal assembly at Project site.
- B. Accessible Lockers: Fabricate as follows:
 - 1. Locate bottom shelf no lower than 15 inches above the floor.
 - 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.
- C. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match lockers.
- D. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
 - 1. Sloping-top corner fillers, mitered.
- E. Recess Trim: Fabricated with minimum 2-1/2-inch face width and in lengths as long as practical; finished to match lockers.
- F. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.
- G. Boxed End Panels: Fabricated with 1-inch- wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.
 - 1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.7 ACCESSORIES

- A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- B. Anchors: Material, type, and size required for secure anchorage to each substrate.
 - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls, and elsewhere as indicated, for corrosion resistance.
 - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. 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 INSTALLATION

- A. General: Install lockers level, plumb, and true; shim as required, using concealed shims.
 - 1. Refer to ASCE 7 Section 13.3.1 and Table 13.5-1.
 - a. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
 - b. Anchor single rows of metal lockers to walls near top and bottom of lockers.
 - c. Anchor back-to-back metal lockers to floor.
- B. Knocked-Down Lockers: Assemble with standard fasteners, with no exposed fasteners on door faces or face frames.
- C. Equipment:
 - 1. Attach hooks with at least two fasteners.
 - 2. Attach door locks on doors using security-type fasteners.
 - 3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
 - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
 - b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.
- D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach recess trim to recessed metal lockers with concealed clips.
 - 2. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
 - 3. Attach sloping-top units to metal lockers, with closures at exposed ends.
 - 4. Attach boxed end panels using concealed fasteners to conceal exposed ends of nonrecessed metal lockers.

- E. Fixed Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.
- F. Accessible Benches: Install against walls or with backrests.

3.3 ADJUSTING

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

3.4 PROTECTION

- A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10 51 13

SECTION 10 56 26.13 – MOBILE STORAGE SHELVING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Mechanically assisted, carriage mounted high-density mobile storage units, support rails, fabrication, and installation including leveling of support rails.
- B. Related Requirements:
 - 1. Structural floor system capable of supporting live and dead loads required by prevailing building codes, including rolling loads of storage units to be installed.
 - 2. Finish floor covering materials and installation.

1.3 SYSTEM DESCRIPTION

- A. General: The system consists of Spacesaver storage units mounted on manufacturer's track-guided carriages to form a compact storage system. System design permits access to any single aisle by manually moving units until the desired aisle is opened. The carriage/rail system provides uniform carriage movement along the total length of travel, even with unbalanced loads.
- B. Carriage System Design and Features: The carriage system consists of a formed structural steel frame with machined and balanced wheels riding on steel rails surface mounted to the floor. Rails shall be types selected by the manufacturer to ensure smooth operation and self-centering of mobile storage units during travel without end play or binding. Rail types, quantities and spacing shall be selected by the manufacturer to suit installation conditions and requirements. All bearings used in the drive mechanism shall be permanently shielded and lubricated.
- C. Movement Controls: Triple or single arm operating wheels with rotating hand knobs shall be provided on the accessible (drive) ends of shelf units, centered on the end panel, located 40 inches from the base of each unit to permit units to be moved to create a single aisle opening. Turning the handle transmits power through chain drive to drive wheels on each carriage.
- D. Drive System: The system shall be designed with a positive type mechanically-assisted drive which minimizes end play, ensures there is no play in the drive handle, and that carriages will stop without drifting.

1. System shall include a chain sprocket drive system for each movable carriage to ensure that carriages move uniformly along the total length of travel, even with unbalanced loads. All system components shall be selected to ensure a smooth, even movement along the entire carriage length. Drive system gearing shall be designed to permit 1 lb. of force applied to the drive handle to move a minimum of 4,000 lbs. of load.
2. A tensioning device shall be provided on each chain drive with provision for adjusting tension without removing end panels.
3. All bearings used in the drive mechanism shall be permanently shielded and lubricated.

E. Safety Features:

1. Color-coded visual indicators shall provide verification that carriages are in a locked or unlocked mode.
2. A single safety lock button, mounted on each operating wheel hub, will permit moving a carriage in either direction to create a new access aisle when pulled out (unlocked), or locking the carriage when pushed in.

F. Finishes:

1. Fabricated Metal Components And Assemblies: Manufacturer's standard powder coat paint finish.
2. End Panels, Accessible Ends: Plastic laminate, manufacturer's standard textures and patterns. Spacesaver's standard powder coat paint finish.

1.4 PERFORMANCE REQUIREMENTS

A. Design Requirements:

1. Limit overall height to 113.5 inches
2. Limit overall length to 556 inches

B. Ease of Movement: Provide mechanically assisted units capable of being moved by exerting a maximum horizontal force of 5 pounds on the operating wheel.

C. Seismic Performance: Provide mobile storage units capable of withstanding the effects of earthquake movement when required by applicable building codes.

D. System must come with structural drawings and calculations to meet or exceed OSHPD seismic regulations.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions for each type of shelving, track and installation accessory required. Include data substantiating that products to be furnished comply with requirements of the contract documents.

B. Shop Drawings: Show fabrication, assembly, and installation details including descriptions of procedures and diagrams. Show complete extent of installation layout including clearances, spacings, and relation to adjacent construction in plan, elevation, and sections. Indicate clear exit and access aisle widths; access to concealed components; assemblies, connections, attachments, reinforcement, and anchorage; and deck details, edge conditions, and extent of finish flooring within area where units are to be installed.

1. Show installation details at non-standard conditions. Furnish floor layouts, technical and installation manuals for every unit shipment with necessary dimensions for rail layout and

- system configuration at the project site. Include installed weight, load criteria, furnished specialties, and accessories.
2. Provide layout, dimensions, and identification of each unit corresponding to sequence of installation and erection procedures. Specifically include the following:
 - a. Location, position and configuration of tracks on all floors.
 - b. Plan layouts of positions of carriages, including all required clearances.
 - c. Details of shelving, indicating method and configuration of installation in carriages.
 3. Provide location and details of anchorage devices to be embedded in or fastened to other construction.
 4. Provide installation schedule and complete erection procedures to ensure proper installation.
- C. Samples: Provide minimum 3 inch square example of each color and texture on actual substrate for each component to remain exposed after installation.
- D. Selection Samples: For initial selection of colors and textures, submit manufacturer's color charts consisting of actual product pieces, showing full range of colors and textures available.
- E. Warranty: Submit draft copy of proposed warranty for review by the Department.
- F. Maintenance Data: Provide in form suitable for inclusion in maintenance manuals for mobile storage units. Data shall include operating and maintenance instructions, parts inventory listing, purchase source listing, emergency instructions, and related information.
1. Submit manufacturer's instructions for proper maintenance materials and procedures.
 2. Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use conditions. Include precautions against using materials and methods which may be detrimental to finishes and performance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Follow manufacturer's instructions and recommendations for delivery, storage and handling requirements.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions before fabrication. Indicate verified measurements on Shop Drawings. Coordinate fabrication and delivery to ensure no delay in progress of the Work.
- B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating mobile storage units. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engage an experienced manufacturer who is ISO 9001 certified for the design, production, installation and service of carriage mounted high-density mobile storage units and support rails. Furnish certificate attesting manufacturer's ISO 9001 quality system registration.

- B. Installer Qualifications: Engage an experienced installer who is a manufacturer's authorized representative for the specified products for installing carriages and anchoring shelving units to carriages.
 - 1. Minimum Qualifications: 1-year experience installing systems of comparable size and complexity to specified project requirements.

1.9 SEQUENCING AND SCHEDULING

- A. Sequencing: Coordinate storage shelving system installation with other work to minimize possibility of damage and soiling during remainder of construction period.
- B. Scheduling: Plan installation to commence after finishing operations, including painting have been completed.
- C. Built-In Items: Provide components which must be built in at a time which causes no delays general progress of the Work.
- D. Pre-installation Conference: Schedule and conduct conference on project site to review methods and procedures for installing mobile storage units including, but not limited to, the following:
 - 1. Review project conditions and levelness of flooring and other preparatory work performed under other contracts.
 - 2. Review and verify structural loading limitations.
 - 3. Recommended attendees include:
 - a. Owner's Representative.
 - b. Prime Contractor or representative.
 - c. Manufacturer's representative.
 - d. Subcontractors or installers whose work may affect, or be affected by, the work of this section.

1.10 WARRANTY / MAINTENANCE

- A. Provide a written warranty, executed by Contractor, Installer, and Manufacturer, agreeing to repair or replace units which fail in materials or workmanship within the established warranty period. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have under General Conditions provisions of the Contract Documents.
- B. Warrant the entire movable compact shelving installation against defects in materials and workmanship for a period of five years from date of acceptance by the Owner.
- C. Provide manufacturer's extended maintenance agreement for one year, commencing on the day the standard maintenance warranty ends.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. General: Products are based upon mobile shelving system products manufactured by Spacesaver Corporation.

MOBILE STORAGE SHELVING UNITS

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1. Or Approved Equal.

2.2 BASIC MATERIALS

- A. General: Provide materials and quality of workmanship which meet or exceed established industry standards for products specified. Material thicknesses/gauges are manufacturer's option unless indicated otherwise.
- B. Plastic Laminates: NEMA LD-3, GP-28, Vertical Grade.

2.3 MANUFACTURED COMPONENTS

- A. Rails:
 1. Material: ASTM/AISI Type 1035 or 1045 steel, manufacturer's selection.
 2. Capacity: 1,000 pounds per lineal foot (1385kg/M) of carriage.
 3. Minimum Contact Surface: 5/8 inch (16MM) wide.
 4. Provide rail sections in minimum 6 foot (1.83M) lengths.
 5. Rail configuration shall permit attachment to top of structural floor system with provision for leveling rails to compensate for variations in floor surface level.
 6. Provide rail connections designed to provide horizontal and vertical continuity between rail sections, to gradually transfer the concentrated wheel point load to and from adjoining rail sections. Butt joints are not permitted.
 7. ADA Rail is required to allow no more than 1/2" gap in rail opening
 8. [Anti-Tip Rail Form Covers: Manufacturer shall provide for protection if required [to prevent damage to rails during concrete back pours.] [when anti-tip devices are installed]. Copy paragraphs below and re-edit for each product.
- B. Floor / Ramp:
 1. Floor/Ramp Sheathing: Minimum 3/4 inch (19MM), 5-ply underlayment grade plywood. Particle board sheathing materials are not permitted.
 2. Provide fire retardant treated floor/ramp materials when required by code.
 3. Finished flooring materials shall be provided by [the Owner] [others].
- C. Carriages:
 1. Provide manufacturer's design movable carriages fabricated of welded or bolted steel construction. Galvanized structural components and/or riveted carriages are unacceptable.
 2. Provide fixed carriages of same construction and height as the movable carriages, anchored to rails. Setting fixed shelving directly on floors is not permitted.
 3. When required, provide bolted carriage splices designed to maintain proper unit alignment and weight load distribution.
 4. Design carriages to allow the shelving uprights to recess and interlock into the carriages a minimum of 3/4 inch (19MM). Top mount carriages are unacceptable.
 5. Provide each carriage with two wheels per rail.
- D. Drive / Guide System:
 1. Design: Provide drive system which prevents carriage whipping, binding and excessive wheel/rail wear under normal operation.
 - a. If line shafts are used, all wheels on one side of carriage shall drive.

- b. If synchronized drives are used, a minimum of one wheel assembly driving both sides of carriage at center location required. Drive shaft shall exhibit no play or looseness over the entire length of that assembly.
 - 2. Shafts: Solid steel rod or tube.
 - 3. Shaft Connections: Secured couplings.
 - 4. Bearing Surfaces: Provide rotating load bearing members with ball or roller bearings. Provide shafts with pillow block or flanged self-aligning type bearings.
- E. Wheels:
- 1. Capacity: Minimum load capacity per wheel: 3200 lbs
 - 2. Size: Minimum 5 inches, outside diameter drive wheels.
 - 3. Guides: Determined by manufacturer; minimum 2 locations.
- F. Face Panels:
- 1. Materials: Plastic laminate clad particle board with plastic edging on vertical edges.
 - 2. Finishes: Selected from Spacesaver's standard available colors and patterns.
- G. Accessories:
- 1. Anti-Tip Devices: Provide manufacturer's standard fixtures.

2.4 GROUT

- A. General: Provide non-shrink, non-staining hydraulic cement compound conforming to the following requirements, based on the performance of the test specimens at room temperature and in laboratory air.
- 1. Linear Movement: No shrinkage while setting; maximum expansion limited to .002 inches per linear inch.
 - 2. Compressive Strength: Based on two inch cubes made following ASTM standards, tested on a Balding-Southward machine of 60,000 pounds capacity, meet or exceed the following:
 - a. Age: 1 hour ---- 4,500 psi 7 days ---- 8,000 psi

2.5 FABRICATION

- A. General: Coordinate fabrication and delivery to ensure no delay in progress of the Work.
- B. Wheels: Provide precision machined and balanced units with permanently shielded and lubricated bearings.
- C. Carriages: Fabricate to ensure no more than 1/4 inch (6MM) maximum deviation from a true straight line. Splice and weld to ensure no permanent set or slippage in any spliced or welded joint when exposed to forces encountered in normal operating circumstances.
- D. Shelving, Supports and Accessories: See individual descriptions in "Shelving" paragraphs.

2.6 FINISHES

- A. Colors: Selected from manufacturer's standard available colors

- B. Paint Finish: Provide factory applied electrostatic powder coat paint. Meet or exceed specifications of the American Library Association.
- C. Laminate Finish: Provide factory applied laminate panels at locations indicated on approved shop drawings.
- D. Edgings: Provide preformed edging, color-matched to unit colors selected.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine floor surfaces with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of mobile storage units.
- B. Verify that building structural system is adequate for installing mobile storage units at locations indicated on approved shop drawings.
 - 1. For installations on existing floors, ensure that rail spacings indicated on shop drawings are in proper locations so existing load-bearing structural members are not over stressed.
- C. Verify that intended installation locations of mobile storage units will not interfere with nor block established required exit paths or similar means of egress once units are installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to proper performance of mobile storage units, once installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Rails:
 - 1. Lay out rails using full length units to the maximum extent possible. Use cut lengths only at ends to attain total length required. Locate and position properly, following dimensions indicated on approved shop drawings. Verify thickness of finished floor materials to be installed (by others) and install level 1/16 inch above finished floor surfaces.
 - 2. Verify level, allowing for a minimum 1/4 inch of grout under high points. Position and support rails so that no movement occurs during grouting.
 - 3. Set rails in full grout bed, completely filling any voids entire length of all rails including rail connectors. Trim up sides flush with rails to ensure proper load transfer from rail to supporting floor. Using shims in lieu of full grouting is not permitted.
 - 4. Installation Tolerances: Do not exceed levelness of installed rails listed below:
 - a. Maximum Variation From True Level Within Any Module: 3/32 inch.
 - b. Maximum Variation Between Adjacent (Parallel) Rails: 1/16 inch, perpendicular to rail direction.
 - c. Maximum Variation In Height: 1/32 inch measured along any 10 foot rail length.
 - 5. Verify rail position and level; anchor to structural floor system with anchor type and spacings indicated on approved shop drawings.

B. Floors/Ramps:

1. General: Finished elevation shall be 1/16 inch below top of rails.
2. Place floors and ramps to the extent indicated on approved shop drawings. Extend ramps under all movable ranges
3. Construct floors and ramps to prevent warping or deformation of floor panels in a normal operating environment. Support panels on levelers at maximum 16 inches on center.
4. Ramp Slope: Do not exceed the following:
 - a. ADA Accessible Ramps: Maximum 1:12 slope (4.76 degrees).

C. Shelving Units Installation:

1. General: Follow layout and details shown on approved shop drawings and manufacturer's printed installation instructions. Position units level, plumb; at proper location relative to adjoining units and related work.
2. Carriages:
 - a. Place movable carriages on rails. Ensure that all wheels track properly and centering wheels are properly seated on centering rails. Fasten multiple carriage units together to form single movable base where required.
 - b. Position fixed carriage units to align with movable units.
3. Shelving Units:
 - a. Permanently fasten shelving units to fixed and movable carriages with vibration-proof fasteners.
 - b. Stabilize shelving units following manufacturer's written instructions. Reinforce shelving units to withstand the stress of movement where required and specified.

3.3 FIELD QUALITY CONTROL

- A. Verify shelving unit alignment and plumb after installation. Correct if required following manufacturer's instructions.
- B. Remove components which are chipped, scratched, or otherwise damaged and which do not match adjoining work. Replace with new matching units, installed as specified and in manner to eliminate evidence of replacement.
- C. Adjust components and accessories to provide smoothly operating, visually acceptable installation.

3.4 DEMONSTRATION / TRAINING

- A. Schedule and conduct demonstration of installed equipment and features with Owner's personnel.
- B. Schedule and conduct maintenance training with Owner's maintenance personnel. Training session should include lecture and demonstration of all maintenance and repair procedures that end user personnel would normally perform.

3.5 PROTECTION AND CLEANING

- A. Protect system against damage during remainder of construction period. Advise Owner of additional protection needed to ensure that system will be without damage or deterioration at time of substantial completion.
- B. Immediately upon completion of installation, clear components and surfaces. Remove surplus materials, rubbish and debris resulting from installation upon completion of work and leave areas of installation in neat, clean condition.

END OF SECTION 10 56 26.13

SECTION 10 70 00 – PROTECTIVE COVERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Work in this section includes furnishing and installation of (1) 24' x 24' Navajo shelter as manufactured by Americana Outdoors and as indicated on drawings.
 - 2. Navajo model shelter is a pre-fabricated structure and hip roof.

1.2 RELATED ITEMS

- A. Concrete for shelter footings.
 - 1. Standard models are surface mounted with anchor bolts supplied by installer.
 - 2. Top of footings shall be sloped to allow water drainage away from post.

1.3 ACTION SUBMITTALS

- A. Furnish shop drawings and confirm dimensions prior to fabrication.
- B. Complete shop drawings available showing structural component locations and positions, material dimensions, and details of construction and assembly.
- C. Structural engineer sealed drawings and calculations available if required.

1.4 QUALITY ASSURANCE

- A. Shelter must conform to applicable national and local building codes.
- B. Manufacturer Qualifications: Minimum 30 years experience in the manufacturing of protective covers of the type specified.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store all shelter components in protected areas until time of installation.

1.6 WARRANTY

- A. Shelter must include a twenty-five (25) year limited warranty on steel against material failure. Ten (10) year warranty against peeling, cracking, blistering, or crazing of the surface finish of aluminum and steel components. One (1) year warranty against defects in material and workmanship.

PROTECTIVE COVERS

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PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Americana Outdoors, #2 Industrial Drive, P.O. Box 1290, Salem, IL 62881; 1-800-851-0865
 - 1. Or Approved Equal

2.2 MATERIALS

- A. Roof
 - 1. Interlocking seam aluminum roof deck shall be roll formed from aluminum alloy 3004-H36 and shall conform to the deck profile shown on the drawings. Roof deck shall be coated with a heat reflective BASF ultra-cool coating or approved equal.
- B. Fascia
 - 1. Gutter fascia extruded from aluminum alloy 6105-T5.
 - 2. Fascia trim extruded from aluminum alloy 6063-T5.
 - 3. Ridge cap extruded from aluminum alloy 6105-T5.
- C. Structure
 - 1. Hollow structural sections (HSS) shall conform to the requirements of ASTM A500, Grade B, $F_y = 46$ ksi.
 - 2. Steel plate is used throughout the shelter and shall conform to ASTM A36. Thickness and size to be determined by engineering calculations.

2.3 ACCESSORIES

- A. Fasteners
 - 1. High strength bolts conform to ASTM A325-N. Bolts shall be hot dip galvanized. Sizes vary from $\frac{1}{2}$ " to $\frac{3}{4}$ " diameter, to be determined by engineering calculations.
 - a. Attaching to steel shall be #12-24 and #5 hex washer head, self-drilling screws shall be stainless steel or coated with zinc.
 - b. Attaching to aluminum shall be 8-18 hex washer head (HWH) #2 point screws u.n.o.

2.4 FABRICATION

- A. Welding shall conform to the American Welding Society's specification for the material being welded. Welding electrodes shall be E70XX. Welders shall be AWS D1.1 certified with welding inspector on staff.
- B. All structural steel components shall be shop fabricated so that field assembly of components can be performed using only bolting and screw placement.

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2.5 FINISHES

- A. All aluminum components are coated with anti-graffiti polyester triglycidyl isocyanurate (TGIC) powder and baked/cured at 400° F. This finish meets AAMA 2604-2 specification.
- B. All steel components are blasted to near-white condition and cleaned with a 3-stage process. Components are sprayed with an alkaline cleaner/phosphatizer, rinsed with ambient water, and a final rinse with a chemical sealer. Components are then coated with anti-graffiti polyester triglycidyl isocyanurate (TGIC) powder and baked/cured at 400° F. This finish meets AAMA 2604-2 specification.
- C. Colors: to be selected by Architect from Mfr full range of color options.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates upon which shelter will be installed with installer present for compliance with requirements for conditions affecting performance or work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Installer shall confirm dimensions and elevations to be as shown on drawings provided by Americana Outdoors.
- D. Installation shall be performed by an experienced installer and scheduled after all concrete and masonry in the area are completed.

3.2 INSTALLATION

- A. Installation shall be in strict accordance with manufacturer's shop drawings. General installation guidelines are supplied with each shelter.
- B. Particular attention should be given to protecting the finish during handling and installation.
- C. After installation, entire system should be left in a clean condition.

END OF SECTION 10 70 00

PROTECTIVE COVERS

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SECTION 10 80 00 – MISCELLANEOUS SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous specialty items applicable to Work and not specified under individual technical sections.

1.2 ACTION SUBMITTALS

- A. Shop drawings and product data for all components, hardware and accessories under provisions of Division 01, General Requirements. Show construction and fabrications details, procedures, layout and erection diagrams, anchorages and pertinent information for specified specialty item.
- B. Manufacturer's installation instructions and maintenance recommendations under provisions of Division 01, General Requirements.
- C. Samples sufficiently sized to illustrate clearly all sizes, available colors, materials, patterns and finishes.

1.3 FIELD CONDITIONS

- A. Verify site conditions. Obtain accurate dimensions of openings, levels, locations and arrangements of embedded and concealed anchorages. Report discrepancies between drawings and field dimensions to Architect before commencing work.

PART 2 - PRODUCTS

2.1 SPECIALTY ITEMS

A. LOCK BOX - INDIVIDUAL SECURITY LOCKER

1. Heavy Duty 3200 Knox-Box surface-mounted. Furnish separate boxes for fire and sheriff's departments at each location shown. Confirm installation locations with local authorities prior to installation.
2. Capacity: 10 keys and access cards.
3. Finish: Polyester powder coat, dark bronze.
4. Manufacturer: The Knox Co., Newport Beach, CA, or equal.

B. DECORATIVE GLASS WINDOW FILM

1. Product: Fasara 7725SE-314 Dusted Crystal White
2. Film Type: Vinyl

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3. Product Color: White
4. Fire Resistance: Class A fire rating per ASTM E84
5. Tensile Strength: 5 lb./in.
6. Manufacturer: 3M, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF JOINT SEALANTS

- A. Install with wall and floor anchors per manufacturer's recommendations.
- B. Provide electrical and mechanical connections to building systems. Wire internal connections when part of unit's functionality.
- C. Install equipment specialties according to manufacturer's recommended procedures.

END OF SECTION 10 80 00

SECTION 11 52 00 - AUDIO VISUAL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes Ultra-Short-Throw Projectors including wall mount and accessories.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of Projector that fail(s) in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two year(s) from date of Substantial Completion. 90 days for lamp.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product:
 - 1. Projector: Epson BrightLink 1485Fi 1080p 3LCD Ultra Short-throw Interactive Display.
 - 2. Mount: Epson wall mount for PowerLite/BrightLink Series – ELPMB62

2.2 SYSTEM DESCRIPTION

- A. Projector:
 - 1. Projection System: Epson 3LCD, 3-chip technology
 - 2. Projection Method: Front/rear/wall mount/table mount

3. Driving Method: Epson Poly-silicon TFT Active Matrix
4. Pixel Number: 1,049,000 pixels (1366 x 768) x 2
5. Color Brightness – Color Light Output: 5,000 lumens
6. White Brightness – White Light Output: 5,000 lumens
7. Aspect Ratio: 16:9
8. Lamp Life: ECO Mode: Up to 30,000 hours, Normal Mode: Up to 20,000 hours
9. Throw Ratio Range: (16:10) 0.30 – 0.42, (4:3) 0.37 – 0.50, (16:9) 0.27 – 0.37
10. Size – projected distance: (16:9) 65" – 100"
11. Keystone Correction: Horizontal: +/- 3 degrees; Vertical: +/- 3 degrees
12. USB Plug n' Play: For Mac: Mac OS 10.7/10.8/10.9/10.10/10.11/macOS 10.12.x
13. For Windows: Windows Vista/Windows 7/Windows 8/Windows 10
14. Contrast Ratio: Up to 2,500,000:1
15. Color Reproduction: Up to 1.07 billion colors
16. Dimensions: 18.1" x 14.3" x 8.3" (W x D x H)
17. Weight: 21.4 lb.
18. Security: Kensington lock provision, security anchor bar, Password Protection function
19. Operating Temperature: 41 degrees to 104 degrees Fahrenheit (5 to 40 degrees Celsius)
20. Projection Lens Type: Manual focus
21. Projection Lens F-number: 1.50
22. Projection Lens Focal Length: 3.9 mm
23. Projection Lens Zoom Ratio: Digital zoom: 1.0 – 1.35x

2.3 ACCESSORIES

- A. Wall Plate – 3221827 C2G 3.5mm – Aluminum.
- B. Coax High Resolution Monitor VGA Cable with Audio – 2409607 StarTech.com 25 ft.
- C. High Speed HDMI Cable – 1855142 Belkin 25 ft.
- D. USB 2.0 A-A Extension / Booster Cable – 698500 IOGEAR 16 ft.
- E. Provide fittings, attachment hardware, and anchor components as required for installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that site conditions are ready to receive work and dimensions are as instructed by the manufacturer, or as shown on Drawings.
- B. Verify internal wall reinforcement prior to installation of items.

3.2 INSTALLATION

- A. Install Short-throw Projector Mounts in accordance with manufacturers' instructions, in locations shown on Drawings.
 1. Mount base plate to wall.

2. Mount the Mounting plate and Switcher to the base plate.
 3. Run cables.
 4. Cable the Switcher.
 5. Attach the Boom Arm, Power Supply, and Projector.
 6. Complete the Installation.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Install Short-throw Projectors in the wall-mounted projector mounts.

3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 11 52 00

SECTION 115313 - LABORATORY FUME HOODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Bench-top High-Performance Laboratory Fume Hoods.
2. Service fixtures (ie. water, gas, etc.) and electrical service fittings in fume hoods.
3. Piping and wiring within service fittings, light fixtures, switches, and other electrical devices.
4. Fume hood base support.
5. Work Surfaces within fume hoods.
6. Laboratory sinks and cup sinks in fume hoods.
7. Filler panels and ceiling enclosures for fume hoods.

- B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for wood blocking for anchoring fume hoods.
2. Division 22: Furnish and installation of plumbing utilities and final connections to fume hoods.
3. Division 23: Furnishing and installation of exhaust duct work and equipment, and final connection of hoods.
4. Division 26: Furnishing and installation of electrical utilities and final connections to hoods.

1.3 COORDINATION

- A. Coordinate layout and installation of framing and reinforcements for lateral support of fume hoods.
- B. Coordinate installation of fume hoods with laboratory casework and other laboratory equipment.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For laboratory fume hoods.
 1. Include plans, elevations, sections, and attachment details.

2. Indicate details for anchoring fume hoods to permanent building construction including locations of blocking and other supports. Include calculations demonstrating that anchorages comply with seismic performance requirements.
 3. Indicate locations and types of service fittings together with associated service supply connection required.
 4. Indicate duct connections, electrical connections, and locations of access panels.
 5. Include roughing-in information for mechanical, plumbing, and electrical connections.
 6. Show adjacent walls, doors, windows, other building components, laboratory casework, and other laboratory equipment. Indicate clearances from the above items.
 7. Include layout of fume hoods in relation to lighting fixtures and air-conditioning registers and grilles.
 8. Include coordinated dimensions for laboratory equipment specified in other Sections.
- C. Samples: For fume hood exterior finishes, interior lining and phenolic-composite work tops.
- D. Delegated-Design Submittal: For fume hoods indicated to comply with seismic performance requirements and design criteria.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish complete touchup kit for each type and color of fume hood finish provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged fume hood finish.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or another suitable material.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install fume hoods until building is enclosed, wet work and utility roughing-in are complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Locate concealed framing, blocking, and reinforcements that support fume hoods by field measurements before being enclosed, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Bypass Fume Hoods with Steel Exterior:
1. Products: Subject to compliance with requirements, provide one of the following:

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- a. Labconco Corporation; Protector ClassMate (5' nominal width).
- B. Source Limitations: Obtain laboratory fume hoods from single manufacturer.
 - 1. Obtain laboratory fume hoods from same source as laboratory casework.
- C. Product Designations: Drawings indicate sizes, types, and configurations of fume hoods by referencing designated manufacturer's catalog numbers. Other manufacturers' fume hoods of similar sizes, types, and configurations, and complying with the Specifications, may be considered. See Section 01 60 00 "Product Requirements."

2.2 PERFORMANCE REQUIREMENTS

- A. Containment: Provide fume hoods that comply with the following when tested according to ASHRAE 110 as modified below:
 - 1. As-Manufactured (AM) Rating: Hood shall achieve a rating of 4.0AM0.00 maximum average and 4.0AM0.01 maximum spike.
 - 2. Average Face Velocity: 60 fpm plus or minus 10 percent with sashes fully open.
 - 3. Sash Position: Fully open.
 - a. Test hoods with horizontal sashes with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.
 - b. Test hoods with combination sashes fully raised, with maximum opening on one side, with maximum opening in the center, and with one opening at each side equal to half of maximum opening.
 - 4. Release Rate: 4.0 L/min.
 - 5. Test Setup Modifications: Conduct tests with a minimum of three and a maximum of five people in the test room and with two 1-gal. round paint cans, one 12-by-12-by-12-inch cardboard box, and three 6-by-6-by-12-inch cardboard boxes in the fume hood during the test. Position items from 6 to 10 inches behind the sash, randomly distributed, and supported off the work surface by 2-by-2-inch blocks.
 - 6. Walk-by Test: At the conclusion of containment test, execute three rapid walk-bys at 30-second intervals, 12 inches behind the mannequin. Test-gas concentration during each walk-by shall not exceed 0.1 ppm and shall return to specified containment value within 15 seconds.
- B. Static-Pressure Loss: Not more than 0.2-inch wg at 60-fpm face velocity with sash fully open when measured at four locations 90 degrees apart around the exhaust duct and at least three duct diameters downstream from duct collar.
- C. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design fume hoods for seismic performance.
- D. Seismic Performance: Fume hoods, including attachments to other work, shall withstand the effects of earthquake motions determined according to California Building Code.

2.3 FUME HOODS

- A. Product Standards: Comply with SEFA 1, "Laboratory Fume Hoods - Recommended Practices." Provide fume hoods UL listed and labeled for compliance with UL 1805.
- B. Bypass Fume Hoods: Provide bypass fume hoods. Compensating bypass above the sash opens as sash is closed. Provide sufficient bypass capacity so that face velocity with sash opening of 6 inches does not exceed 3 times the face velocity with sash fully open.

2.4 MATERIALS

- A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A1008/A1008M; matte finish; suitable for exposed applications.
- B. Glass-Fiber-Reinforced Polyester: Polyester laminate with a chemical-resistant gel coat on exposed faces, and having a flame-spread index of 25 or less according to ASTM E84.
- C. Polypropylene: Unreinforced polypropylene complying with ASTM D4101, Group 01, Class 1, Grade 2.
- D. Glass: Clear, laminated tempered glass complying with ASTM C1172, Kind LT, Condition A, Type I, Class I, Quality-Q3; with two plies not less than 3.0 mm thick and with clear, polyvinyl butyral interlayer.
 - 1. Ultraclear Glass: Glass plies each have visible light transmission not less than 91 percent.
 - 2. Safety Glass: Provide products complying with testing requirements in 16 CFR 1201 for Category II materials.
 - 3. Permanently mark safety glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Fasteners: Provide stainless steel fasteners where exposed to fumes.

2.5 FABRICATION

- A. General: Assemble fume hoods in factory to greatest extent possible. Disassemble fume hoods only as necessary for shipping and handling limitations. Fume hoods shall be capable of being partly disassembled as necessary to permit movement through a 35-by-79-inch door opening.
- B. Steel Exterior: Fabricate from steel sheet, 0.048 inch thick, with component parts screwed together to allow removal of end panels, front fascia, and airfoil and to allow access to plumbing lines and service fittings. Apply chemical-resistant finish to interior and exterior surfaces of component parts before assembly.

- C. Ends: Fabricate with double-wall end panels without projecting corner posts or other obstructions to interfere with smooth, even airflow. Close area between double walls at front of fume hood and as needed to house sash counterbalance weights, utility lines, and remote-control valves.
- D. Splay top and sides of face opening to provide an aerodynamic shape to ensure smooth, even flow of air into fume hood.
- E. Hood Liner:
 - 1. Secure interior glass liner components to superstructure.
 - 2. Stainless steel fasteners shall be used on the interior ceiling for structural integrity.
 - 3. Punch fume hood fixture panels to receive four service fittings, for use with remote controls, per side. Provide removable plug buttons for holes not used for indicated fittings.
 - 4. Each side wall shall include a rectangular interior access panel to provide access to the side wall of the fume hood for plumbing service access. Access panel material shall be steel with a chemical resistant finish.
- F. Hood Baffle:
 - 1. Baffle system shall be fixed, and designed to capture a wide range of gaseous densities without adjustment or moving components.
 - 2. Shall provide a continuous horizontal slot at the work surface.
 - 3. The baffle system shall be constructed with the same material as the fume hood liner.
 - 4. The baffles shall be able to be pivoted for cleaning. The primary baffles shall be three pieces to allow removal if necessary.
 - 5. Moving parts or adjustment of any kind is not acceptable.
- G. Exhaust Connection:
 - 1. 316 stainless steel with Chemical-Resistant Finish
 - 2. 12.81 inch ID to accommodate any 12 inch nominal duct without the need for a transition adapter. Hoods have one exhaust connection. Additional components required to accommodate 12 inch nominal mechanical system are not acceptable.
 - 3. Ducting shall go inside the duct collar to ensure condensate travels into the hood and evaporates. Duct collars that allow duct connection over the collar are not acceptable.
- H. Airfoil:
 - 1. Cold Rolled Steel with Chemical-Resistant Finish.
 - 2. Low profile, flush airfoil directs airflow across work top to rear baffle.
 - 3. Airfoil shall have 1-1/4 inch deep spill trough and shall require no cabinet overhang.
 - 4. Must have 3 rows of perforations to allow the air to bypass underneath and through the foil and sweep across the work surface to prevent any back flow of fumes escaping from the front of the hood opening.
 - 5. Foil must extend back under the sash to prevent closure of the lower by-pass opening when the sash is in the fully closed position, directly on top of the airfoil.
- I. Sash Assembly:
 - 1. Glass: Fully glaze with laminated safety glass with unobstructed, side-to-side view of fume hood interior and service fixture connections.
 - 2. Dimensions: The full sash opening height is 28 inches, the total unobstructed viewing height is 37-1/2 inches measured from the work surface.

3. Sash Tracks: Steel with Chemical Resistant Finish. Shall include bump stops for opening and closing.
4. Sash Handle: extruded aluminum with Chemical Resistant Finish. Sash handle includes a perforated air passage directly atop the handle to bleed air into the hood chamber and direct chemical fumes away from the user's breathing zone. The handle is ergonomic in design and is easy to grasp when operating
5. Sash Guides: Corrosion resistant extruded poly-vinyl chloride.
6. Sash System:
 - a. Vertical Sash (Chain and Sprocket):
 - 1) Hoods have a single vertical sash counterbalanced by a single weight with a 5 degree angle.
 - 2) Sash and weight to be connected via #35 chains.
 - 3) Rear sprockets shall be connected via timing shaft to prevent sash tilting and permit one finger operation at any point along full width sash handle. Maximum 7 pounds pull required to raise or lower sash throughout its full length of travel.
 - 4) Design system to hold sash at any position without creep and to prevent sash drop in the event of chain failure.

J. Electrical Components:

1. Lighting:
 - a. Provide UL Listed, high-efficiency, quick-start, LED lighting systems, including bulbs.
 - 1) 5 Foot Hoods - 2 each, 4-foot 17-watt LED lamps
 - b. Vapor-Proof: all electrical components shall be outside of the contaminated air space. Lighting shall be located behind a laminated safety glass shield, sealed to the top of the hood liner.
 - c. The LED light assemblies shall be serviceable from outside the fume hood cavity, without the use of tools.
 - d. Light switch to be included on the lower right corner post, at heights compliant with the Americans with Disabilities Act (ADA).
2. Blower Switch:
 - a. Hoods shall be provided with blower switch, on the lower right corner post, at heights compliant with the Americans with Disabilities Act (ADA).
3. Electrical Receptacles:
 - a. The hoods shall accommodate up to two (one per corner post) electrical receptacles as indicated in schedule or drawings. Options to include:
 - 1) 115 volt, 60 Hz, three-wire polarized and grounded electrical duplex
 - 2) 115 volt, 60 Hz, three-wire polarized and grounded electrical duplex, with Ground Fault Circuit Interruption (GFCI)
 - 3) 230 volt, 60 Hz, three-wire polarized and grounded electrical duplex.

- b. Each 115v electrical duplex shall be rated at 20 Amperes, each 230v electrical duplex shall be rated at 10 Amperes.
 - c. Cover plates shall be acid resistant thermoplastic.
- 4. Wiring:
 - a. Every electrical component shall be individually wired to a single point internal field wiring box (including individual duplexes/receptacles).
 - b. Field wiring box to be 7" x 4" x 2.5", grounded, and have (12) 7/8" diameter knock out penetrations.
 - c. Final wiring and circuit dedication is to be by others.
 - d. Each receptacle circuit shall accommodate being wired to a dedicated building circuit rated at 20A, or the receptacles ganged together on a building circuit with the total load not exceeding 20 Amperes.
- 5. Fume hood to have third party validation of compliance to UL 1805 and UL 61010-1 by a Nationally Recognized Testing Laboratory (NRTL)
- K. By-Pass Opening:
 - 1. The size of the by-pass opening is controlled by sash position for use with a constant volume mechanical system. The hood shall not have a change in static pressure or exhaust volume across all sash positions.
- L. Hood Safety Practices Label: Corrosion resistant plate attached to the corner post of the fume hood with the following Hood Safety Practices:
 - 1. For use with substances that produce hazardous levels of airborne chemicals: gas, fumes, vapors, dust
 - 2. Do not put your head in the hood.
 - 3. Minimize drafts and sudden movements in front of the hood.
 - 4. Work a minimum of six inches inside the hood.
 - 5. Elevate equipment above the work surface.
 - 6. Keep sill and baffle unobstructed.
 - 7. Do not use the hood for storage.
 - 8. Adjust the sash to smallest opening possible when in use.
 - 9. Close sash when unattended.
 - 10. Do not remove any of the hood components.
 - 11. Do not place flammable solvents near heat, flame or sparks.
 - 12. Do not evaporate large amounts of flammable liquids.
 - 13. Wipe up spills immediately.
 - 14. Routinely validate airflow.
 - 15. If the ventilation system malfunctions, or airflow alarm indicates unsafe condition, close sash and discontinue hood operation immediately-call for help.
 - 16. Do not use with Biohazards and Perchloric Acid
- M. Filler Strips: Provide as needed to close spaces between fume hoods or fume hood base cabinets and adjacent building construction. Fabricate from same material and with same finish as fume hoods or fume hood base cabinets, as applicable.
- N. Ceiling Extensions: Provide filler panels matching fume hood exterior to enclose space above fume hoods at front and sides of fume hoods and extending from tops of fume hoods to ceiling.

- O. Finished Back Panels: Where rear surfaces of fume hoods are exposed to view, provide finished back panels matching rest of fume hood enclosure.
- P. Comply with requirements in other Sections for installing water and laboratory gas service fittings, piping, electrical devices, and wiring. Install according to Shop Drawings. Securely anchor fittings, piping, and conduit to fume hoods unless otherwise indicated.

2.6 FUME HOOD BASE CABINETS, WORK TOPS, SINKS AND SERVICE FITTINGS

- A. Comply with Section 12 35 53.19 "Wood Laboratory Casework."

2.7 CHEMICAL-RESISTANT FINISH

- A. General: Prepare, treat, and finish welded assemblies after welding. Prepare, treat, and finish components that are to be assembled with mechanical fasteners before assembling. Prepare, treat, and finish concealed surfaces same as exposed surfaces.
- B. Preparation: Clean steel surfaces, other than stainless steel, of mill scale, rust, oil, and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.
- C. Chemical-Resistant Finish: Immediately after cleaning and pretreating, apply fume hood manufacturer's standard two-coat, chemical-resistant, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
 - 1. Chemical and Physical Resistance of Finish System: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8M. Acceptance level for chemical spot test shall be no more than four Level 3 conditions.
 - 2. Colors for Fume Hood Finish: As selected by Architect from manufacturer's full range.

2.8 ACCESSORIES

- A. Airflow Indicator and Alarm: Provide each fume hood with manufacturer's standard airflow indicator with audible and visual alarm that activates when airflow sensor reading is outside of preset range.
- B. Audio/Visual Airflow Monitor
 - 1. Provide audible and visual alarm in the event of an unsafe face velocity.
 - 2. Alarm must sit flush with the fume hood corner post.
 - 3. Based on a thermally compensated thermistor in the alarm module, and air passing through a separate airstream into the hood interior.
 - 4. LED lights display red for alarm and green for normal operation.
 - 5. Must include external alarm and night setback functions.
 - 6. Alarm mute shall be accessible from the front of the monitor; visual alarm must remain activated until alarm condition is corrected.
 - 7. UL Listed electrical components
 - 8. Calibration shall be through a front located potentiometer.

LABORATORY FUME HOODS

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9. Calibration is the responsibility of the owner, following a complete balancing of the mechanical system, and concurrently with As-Installed testing.
- C. Sash Alarm: Provide fume hoods with audible and visual alarm that activates when sash is opened beyond preset position.
 1. Provide with silence and test switches.
- D. Sash Stops: Provide fume hoods with sash stops to limit hood opening to 50 percent of sash height. Sash stops can be manually released to open sash fully for cleaning fume hood and for placing large apparatus within fume hood.

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

3.2 INSTALLATION

- A. General: Install fume hoods according to manufacturer's written instructions. Install level, plumb, and true; shim as required, using concealed shims, and securely anchor to building and adjacent laboratory casework. Securely attach access panels but provide for easy removal and secure reattachment. Where fume hoods abut other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Comply with requirements in Section 123553.19 "Wood Laboratory Casework" for installing fume hood base cabinets, work tops, and sinks.
- C. Comply with requirements for installing water and laboratory gas service fittings and electrical devices.
 1. Install fittings according to Shop Drawings, installation requirements in SEFA 2.3, and manufacturer's written instructions. Set bases and flanges of sink and work top-mounted fittings in sealant recommended by manufacturer of sink or work-top material. Securely anchor fittings to fume hoods unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

- A. Field test installed fume hoods according to "Flow Visualization and Velocity Procedure" requirements in ASHRAE 110.
 1. Test one installed fume hood, selected by Architect, for each type of hood installed, according to ASHRAE 110 as modified in "Performance Requirements" Article. If tested

hood fails to meet performance requirements, field test additional hoods as directed by Architect.

- B. Field test installed fume hoods according to ASHRAE 110 as modified in "Performance Requirements" Article to verify compliance with performance requirements.
 - 1. Adjust fume hoods, hood exhaust fans, and building's HVAC system, or replace hoods and make other corrections until tested hoods perform as specified.
 - 2. After making corrections, retest fume hoods that failed to perform as specified.

3.4 ADJUSTING AND CLEANING

- A. Adjust moving parts for smooth, near silent, accurate sash operation with one hand. Adjust sashes for uniform contact of rubber bumpers. Verify that counterbalances operate without interference.
- B. Clean finished surfaces, including both sides of glass; touch up as required; and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION 115313

SECTION 11 61 13 – THEATRICAL LIGHTING FIXTURES AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes all labor, materials, equipment and services necessary to furnish and deliver to the job site the Theatrical Lighting Fixture package specified herein, including but not limited to, the following:
 - 1. Theatrical lighting fixtures, lamps and accessories.
 - 2. Hardware and jumper cables.
 - 3. Miscellaneous items.
 - 4. Equipment installation.
- B. It shall be the responsibility of the Theatrical Lighting Fixture Supplier to furnish equipment complete in all respects and to provide any additional equipment required to fulfill the intent of these drawings and specifications regardless of whether or not such items are herein specified or indicated.

1.3 SUBMITTALS WITH BID

- A. Theatrical Lighting Fixture Supplier shall provide a list of all items with manufacturer's catalog numbers for each item.
- B. Bid shall include a unit price for each item listed in 2.3 of this Specification.
 - 1. Unit pricing may be used by the Owner to determine the value of any additions to or deletions from the equipment list.
 - 2. Failure to provide unit pricing may result in the disqualification of the bid.
- C. Theatrical Lighting Fixture Supplier shall submit with bid the following time estimates
 - 1. Length of time required to supply all equipment.
 - 2. Length of time required to install all equipment.

1.4 SUBMITTALS

- A. Theatrical Lighting Fixture Supplier shall submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Shop drawings shall include catalogue cuts and quantities of all items listed in the Theatrical Lighting Fixture & Accessories Schedule on QT6.03 for review.
- C. Shop drawings shall include suggested fixture plot for review by Owner's representative.

THEATRICAL LIGHTING FIXTURES AND ACCESSORIES

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- D. Provide unit pricing for all items listed in the Theatrical Lighting Fixture & Accessories Schedule on QT6.03 for Owner and Specifier review.

1.5 THEATRICAL LIGHTING FIXTURE SUPPLIERS

- A. Theatrical Lighting Fixture Suppliers for Work of this Section include the following:
 - 1. Holzmüller Corporation – San Francisco, CA – 415-826-8383
 - 2. Musson Theatrical Inc. – Santa Clara, CA – 408-986-0210
 - 3. Sacramento Theatrical Lighting – Sacramento, CA – 916-447-3258

1.6 DELIVERY

- A. Delivery shall be as required in the Contract Documents.
 - 1. Theatrical Lighting Fixture Supplier shall confirm the delivery dates with the Construction Manager and/or Owner a minimum of 30 days in advance of scheduled delivery.
- B. Bid price shall include full freight and insurance charges for delivery of all of the equipment to the job site.
- C. Deliver all material to the job site suitably crated, packed, and protected.
 - 1. Each crate or carton shall be clearly marked on the outside with the manufacturer's identification labels and the nomenclature of the product contained within.

1.7 THEATRICAL LIGHTING FIXTURE INSTRUCTION

- A. Theatrical Lighting Fixture Supplier shall provide Owner's designated representative(s) with up to four (4) hours of instruction in the configuration, programming and operation of the LED theatrical lighting fixtures.

1.8 WARRANTY

- A. The Theatrical Lighting Fixture Supplier shall assure that this equipment is provided free of defects in materials and workmanship and shall provide a warranty under this contract agreeing to make all applicable repairs, including replacement of materials, at no cost to the Owner for a period of one (1) year from the date of final acceptance.
- B. If, through no fault on the part of the Owner, the Theatrical Lighting Fixture Supplier is unable to meet the required delivery dates established at the time of the signing of an agreement, Fixture Supplier agrees to furnish substitute equipment of the same quantity and of comparable type and quality to the job site.
 - 1. This equipment will be extended to the Owner at no additional cost until the delivery of the presentation area lighting fixture list has been completed.

PART 2 - PRODUCTS

2.1 THEATRICAL LIGHTING FIXTURES

- A. LED theatrical lighting fixtures shall be supplied with all standard accessories as noted in the Theatrical Lighting Fixtures & Accessories Schedule in the drawings.
- B. The manufacturer(s) for each fixture is included in this Specification. No substitutions will be allowed without prior approval by official Substitution Request at time of bid, and each item furnished shall conform in all respects to the product description found on the data sheets.

2.2 JUMPER CABLES

- A. All 20A jumpers shall be made of black type "SO" (extra hard usage), three (3) conductor, #12 cable with specified colored tape at each end and installed Edison parallel blade U ground connectors.
 - 1. All jumpers shall be made with strict observance of polarity.
- B. All PowerCON to PowerCON fixture to fixture Power Thru jumper cables shall be made of black type "SJ" (junior hard service), three (3) conductor, #12 cable with installed standard Neutrik PowerCON connectors.

PART 3 - EXECUTION

3.1 INSTRUMENT PREPARATION

- A. After delivery and prior to installation, each theatrical lighting fixture shall undergo the following:
 - 1. Unpacking from carton.
 - a. Single carton with packing material shall be turned over to Owner for each fixture type. All other cartons and debris shall be removed from the site by the Theatrical Lighting Fixture Supplier.
 - 2. Installation of C-clamp and all associated hardware, including safety cable.
 - 3. Installation and bench-focusing of fixture.

3.2 INSTALLATION

- A. Install theatrical lighting fixtures in locations based on Supplier's suggested fixture plot and as directed by Owner's Representative.
- B. Connect theatrical lighting fixtures to nearest theatrical lighting wiring and control devices using jumper cables, DMX cables, etc. as required or as directed by Owner's Representative.
- C. Focus all theatrical lighting fixtures as directed by Owner's Representative.

3.3 INSTALLATION SUPERVISION

- A. Installation of the theatrical lighting fixtures shall be supervised by the Theatrical Lighting Fixture Supplier's own experienced superintendent having extensive experience in installing instruments of this kind.
- B. The same individual shall remain in charge of the work throughout the installation of the theatrical lighting fixtures until work is completed excepting only the intervention of circumstances completely beyond the control of the Theatrical Lighting Fixture Supplier.
- C. The superintendent shall represent the Theatrical Lighting Fixture Supplier and all directions given to him shall be binding as if given to the Theatrical Lighting Fixture Supplier.

3.4 INSTALLATION LABOR

- A. The Theatrical Lighting Fixture Supplier shall carry out the installation of the theatrical lighting fixtures using experienced professional theatrical rigging technicians.
- B. The Theatrical Lighting Fixture Supplier shall not employ any person to do work of a particular craft unless that person is qualified in that craft.
- C. No unskilled laborer shall be permitted to work as a mechanic or to do the work of a craftsman.

3.5 FIELD QUALITY CONTROL AND WORK

- A. Responsibility for the satisfactory installation, plugging and focusing of these theatrical lighting fixtures shall rest solely and exclusively with the Theatrical Lighting Fixture Supplier.
- B. The Theatrical Lighting Fixture Supplier shall be responsible for furnishing and storing of all equipment and tools during the period of installation, including access equipment.
- C. The Theatrical Lighting Fixture Supplier shall be responsible for collecting and removing from the job site all packing materials, trash, scrap materials, etc.
- D. The Theatrical Lighting Fixture Supplier shall be responsible for the protection of equipment and/or finished materials provided by other Contractors.
- E. Prior to the completion of the installation, the Theatrical Lighting Fixture Supplier shall notify the Owner's Representative to arrange a date for observation of the installation.
 - 1. Any equipment which fails to meet with the Specifications shall be repaired or replaced with new equipment, and the observation shall be re-scheduled under the same conditions listed previously.
 - 2. Final approval will be withheld until all fixtures and equipment have been thoroughly tested and found to be in first class operating condition in every circumstance. Stage lighting control console will be patched, and a magic sheet provided for Owner training and use.

END OF SECTION 11 61 13

THEATRICAL LIGHTING FIXTURES AND ACCESSORIES

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SECTION 11 61 16 – THEATRICAL WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes all labor, materials, equipment and services necessary to manufacture and deliver to job site, for installation by Electrical Contractor, theatrical wiring devices, including back boxes, as shown on the QT drawings and/or specified herein, including but not limited to the following:
 - 1. Recessed receptacle boxes
 - 2. Surface mount receptacle boxes
 - 3. Pipe mount receptacle boxes
- B. It shall be the responsibility of the Theatrical Wiring Device Manufacturer to furnish equipment complete in all respects and to provide any additional equipment required to fulfill the intent of these drawings and specifications regardless of whether or not such items are herein specified or indicated.

1.3 MANUFACTURING STANDARDS

- A. All work shall be manufactured in accordance with the latest editions of applicable publications and standards of the following organizations:
 - 1. National Electric Code (NEC) and all prevailing local and state regulations
 - 2. National Electrical Manufacturers Association (NEMA)
 - 3. Occupational Safety & Health Act (OSHA)
- B. All applicable products shall bear label of Underwriters Laboratories (UL).
- C. All equipment shall be thoroughly tested in Manufacturer's shop prior to shipment to insure mechanical and electrical integrity.

1.4 SUBMITTALS

- A. Theatrical Wiring Device Manufacturer shall prepare and submit complete shop drawings according to requirements set forth in the Contract Documents.
- B. Shop drawings shall show bussing for each outlet box and shall utilize the exact circuit numbering method detailed on the drawings.
- C. Furnish catalog cuts, drawings, and/or descriptive material of catalog items as requested by the Architect. Confirm weight for each device to show conformance with drawings.

THEATRICAL WIRING DEVICES

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- D. Furnish all of the above for review by the Architect prior to commencing any work.
 - 1. Such review does not relieve the Wiring Device Manufacturer of the responsibility of providing equipment in accordance with this Specification.
- E. Any deviation from this Specification is to be "starred" and noted in letters a minimum 1/4" high.
 - 1. In order for a deviation to be considered it shall upgrade the quality of the equipment or respond to a field condition.

1.5 THEATRICAL WIRING DEVICE MANUFACTURERS

- A. Theatrical Wiring Device Manufacturers for work of this section shall include:
 - 1. Altman Lighting, Yonkers, NY
Contact: Nick Champion nchampion@altmanltg.com 800-425-8626
 - 2. Electronic Theatre Controls (ETC), Middleton, WI
Contact: Randy Pybas randy.pybas@etcconnect.com 800-688-41163
 - 3. Lex Products, Shelton, CT
Contact: Tom Siko tsiko@lexproducts.com 800-643-4460
 - 4. Performance Electric Inc., Greenville, SC
Contact: Larry Easterday save@performancedistro.com 864-288-2021
 - 5. SSRC, Duncan, SC
Contact: Aaron Clark aclark@ssrconline.com 864-848-9770
 - 6. Stagecraft Industries Inc., Portland, OR
Contact: Kevin Shetterly kevins@stagecraftindustries.com 503-286-1600

1.6 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.

1.7 COORDINATION

- A. Coordinate lighting control components to form an integrated interconnection of compatible components.
 - 1. Match components and interconnections for optimum performance of lighting control functions.
 - 2. Coordinate lighting controls with BAS if applicable. Design display graphics showing building areas controlled; include the status of lighting controls in each area.
 - 3. Coordinate lighting controls with that in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.
- B. Coordinate lighting control loads specified in this Section with components providing overcurrent protection as specified in Division 26 Section "Panelboards."

1.8 LABELING

- A. All theatrical wiring devices shall be permanently identified with means and methods as noted on the drawings and elsewhere in this specification.
- B. Each faceplate and back box shall be tagged with a removable label identifying the WD box number.

1.9 DELIVERY

- A. Delivery shall be as required in Construction Documents.
- B. The Theatrical Wiring Device Manufacturer shall coordinate delivery of all equipment with the Construction Manager and/or Electrical Contractor.
- C. Theatrical Wiring Device Manufacturer shall, if requested by the Construction Manager and/or Electrical Contractor, deliver theatrical wiring devices items in the following two (2) separate shipments:
 - 1. Shipment #1: Shipment shall include back boxes for all theatrical wiring device items so that the Electrical Contractor may terminate all conduit.
 - 2. Shipment #2: Shipment shall include faceplates for all theatrical wiring device items.
 - 3. Theatrical Wiring Device Manufacturer shall notify the Construction Manager and/or Electrical Contractor 24 hours prior to delivery of equipment.
- D. Deliver all material to the job site suitably crated, packed, and protected.
 - 1. Each crate or carton shall be clearly marked on the outside with the Manufacturer's identification label and the nomenclature of the product contained within.

1.10 QUALITY ASSURANCE

- A. Manufacturer: Minimum 10 years' experience in manufacture of architectural and theatrical lighting controls.
- B. Manufacturer's Quality System: Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.
- C. Source Limitations: Obtain lighting control and power distribution components through one source from a single manufacturer wherever possible. All components shall be furnished by the Integrator regardless of source.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with 47 CFR, Subparts A and B, for Class A digital devices.
- F. Comply with NFPA 70.

1.11 WARRANTY

- A. The Wiring Device Manufacturer shall assure that this equipment is provided free of defects in materials and workmanship and shall provide a warranty under this contract for a period of two (2) year from the date of final acceptance.
- B. During the warranty period, repair or replacement of defective materials and/or repair of faulty workmanship shall be provided, at no cost to the Owner, within ten (10) days written notice of the defect(s).

PART 2 - PRODUCTS

2.1 RECESSED AND SURFACE MOUNT RECEPTACLE BOXES

- A. Provide recessed and surface mount receptacle boxes as listed herein and shown on the drawings.
- B. Steel face plates with receptacles shall be constructed of min. 18 gauge steel, painted black.
 - 1. Provide mounting holes on faceplate.
 - 2. White circuit numbers, 1/4" in height, shall be engraved directly into a black lamicaid or plastic laminate label plate attached with non-corroding screw fasteners or rivets.
- C. Provide solid copper buss bars for each receptacle plate as follows:
 - 1. Adjacent neutral pairs for each circuit.
 - 2. Adjacent hot leg pairs for each circuit.
 - 3. Grounds for each receptacle plate.
- D. Boxes shall be prewired with 125o Celsius high temperature wire to molded barrier terminal blocks.
- E. All connectors shall be as shown on the drawings.
- F. Back boxes for surface and recessed mounted receptacle boxes shall be constructed of min. 18 gauge steel, painted black.

2.2 PIPE MOUNTED RECEPTACLE BOXES

- A. Provide pipe mount receptacle boxes as listed herein and shown on the drawings.
- B. Steel face plates with receptacles shall be constructed of min. 18 gauge steel, painted black.
 - 1. Provide mounting holes on face plate.
 - 2. White circuit numbers, 1/4" in height, shall be engraved directly into a black lamicaid or plastic laminate label plate attached with non-corroding screw fasteners or rivets.
- C. Provide solid copper buss bars for each receptacle plate as follows:
 - 1. Adjacent neutral pairs for each circuit.
 - 2. Adjacent hot leg pairs for each circuit.
 - 3. Grounds for each receptacle plate.

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- D. Boxes shall be prewired with 125o Celsius high temperature wire to molded barrier terminal blocks.
- E. All connectors shall be as shown on the drawings.
- F. Back boxes shall be constructed of min. 18 gauge steel, painted black.
- G. Boxes shall attach to battens with U-bolts.

PART 3 - EXECUTION

3.1 EXECUTION

- A. Verify that surfaces are ready to receive work.
- B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts existing conditions.
- E. Install in accordance with manufacturer's instructions and approved shop drawings.
- F. All wiring shall be installed in conduit.
- G. All branch load circuits shall be live tested before connecting the loads to the lighting control panels.

END OF SECTION 11 61 16

SECTION 11 61 19 – THEATRICAL LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
- B. Theatrical lighting control system
 1. Feed-through relay panels, as indicated on drawings
 2. Ethernet control distribution system with Ethernet taps, network switches, and patch bays, and with interface to architectural control processor
 3. DMX-512 control distribution system and Ethernet-to-DMX gateways
 4. Rack and panel enclosures for equipment
 5. Stage lighting control console and accessories
- C. Architectural lighting control system
 1. Lighting control network processor with interfaces to building automation system, fire alarm system, and related input/output interfaces
 2. Pushbutton and touch-screen architectural lighting control stations
 3. Occupancy / vacancy sensors and daylight sensors
 4. UL924 DMX Bypass controllers
- D. It shall be the responsibility of the Lighting Control System Manufacturer to furnish equipment complete in all respects and to provide any additional equipment required to fulfill the intent of these drawings and specifications regardless of whether or not such items are herein specified or indicated.

1.3 MANUFACTURING STANDARDS

- A. All work shall be manufactured in accordance with the Division 26 specifications, the latest editions of applicable publications, and standards of the following organizations:
 1. National Electric Code (NEC) and all prevailing local and state regulations including:
 - a. ANSI/NFPA 70: National Electrical Code
 2. Entertainment Services and Technology Association (ESTA) including:
 - a. ANSI/ESTA E1.3-2001(R2016): Lighting Control Systems – 0-10V Analog Control Specification
 - b. ANSI/ESTA E1.11-2008 (R2018): USITT DMX512-A
 - c. ANSI/ESTA E1.17-2015: Architecture for Control Networks (ACN)
 - d. ANSI/ESTA E1.20-2010: Remote Device Management over USITT DMX512
 - e. ANSI/ESTA E1.27-1-2006 (R2016): Portable Control Cables for DMX512
 - f. ANSI/ESTA E1.27-2-2009 (R2014): Permanently Installed Control Cables for DMX512

- g. ANSI/ESTA E1.31-2018: ACN transport of DMX-512
- 3. Occupational Safety & Health Act (OSHA)

1.4 SUBMITTALS

- A. Lighting Control System Manufacturer shall prepare and submit complete shop drawings according to the requirements set forth in the Contract Documents.
- B. Product Data Sheets
 - 1. For Manufacturer standard panels, enclosures, modules, devices, and other equipment, with options and other variables clearly noted on data sheets.
- C. Shop Drawings
 - 1. Shop drawings shall be reviewed by the Architect before fabrication shall begin.
 - a. Such review does not relieve the Lighting Control System Manufacturer of the responsibility of providing equipment in accordance with this Specification.
 - 2. Shop drawings shall show optical or transformer isolation of all control data lines between dimmer racks, panels, and architectural lighting processor.
 - 3. Shop drawings shall show materials, finishes, metal gauges, overall and detail dimensions, sizes, electrical and mechanical connections, fasteners, welds, provisions for the work of others, and similar information.
 - 4. Shop drawings shall indicate complete details of equipment, including manufacturer's catalog numbers for components, and shall include complete wiring diagrams. Confirm weight for each device to show conformance with drawings.
 - 5. Any deviation from this Specification shall be "starred" and noted in letters a minimum 1/4" high.
 - a. In order for a deviation to be considered, it shall upgrade the quality of the equipment or respond to a field condition.
 - 6. The reviewed shop drawings shall be updated to show any changes made during manufacturing and assembly and shall be sent to the Architect before the equipment is delivered.
- D. Lighting Control System Manufacturer shall provide installation instructions for all equipment. These instructions shall include connection diagrams, termination designations, etc.
- E. Coordination Drawings:
 - 1. Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.
 - a. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
 - b. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.
 - c. Coordinate zoning and fixture addressing with Electrical Contractor. Provide fixture address list for all architectural lighting fixtures controlled by system. Electrical Contractor to provide control riser for architectural lighting layout for review and coordination based on wire runs.
- F. After the installation is complete, the Lighting Control System Manufacturer shall provide the Owner with Operations and Maintenance Manuals not more than fourteen (14) days after the checkout is completed.
 - 1. One (1) O&M manual shall be a printed "hard" copy and O&M manual shall also be provided in electronic format on two (2) flash drives.

2. Each O&M manual shall include, but not be limited to, the following:
 - a. Copies of all "record" shop drawings.
 - b. Detailed panel schedules and architectural fixture addresses / patch information.
 - c. Catalog cuts of all equipment provided.
 - d. Recommendations for periodic maintenance.
 - e. Catalog numbers and manufacturer's names and addresses for perishable items such as pilot lamps and fuses.
 - f. Diagnostic procedures.
 - g. Internet address for online access to manuals, product literature and troubleshooting guides.
 - h. Emergency and normal repair telephone contact sheet for 7-day, 24-hour service.
3. Lighting Control System Manufacturer shall provide the Owner with three (3) instruction manuals for each control console type.
 - a. Instruction manual shall be supplied to the Owner's Representative on the day of the Lighting Control System checkout.
 - b. Instruction manuals may be requested by the Owner's Representative at a date prior to the system checkout.

1.5 SYSTEM INTEGRATORS

- A. System Integrator shall be responsible for scope outlined in this Specification and for the following related Specification sections:
 1. 116106 – Stage Wiring Devices
 2. 116109 – Stage Lighting Fixtures and Accessories
- B. System Integrator must have minimum five (5) years' experience with supply, installation, commissioning, and integration of theatrical and architectural lighting control systems. System Integrator must have at least ten (10) recent projects of similar scope and characteristics to those specified herein.
- C. System integrator shall be responsible for furnishing factory authorized personnel for system startup, programming, commissioning, and Owner training.
 1. System Integrators for the Work of this Section include:
 - a. Holzmüller Corporation – San Francisco, CA – 415-826-8383
 - b. Musson Theatrical Inc. – Santa Clara, CA – 408-986-0210
 - c. Sacramento Theatrical Lighting – Sacramento, CA – 916-447-3258

1.6 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.

1.7 COORDINATION

- A. Coordinate lighting control components to form an integrated interconnection of compatible components.
 1. Match components and interconnections for optimum performance of lighting control functions.

THEATRICAL LIGHTING CONTROL SYSTEM

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2. Coordinate lighting controls with BAS if applicable. Design display graphics showing building areas controlled; include the status of lighting controls in each area.
 3. Coordinate lighting controls with that in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.
- B. Coordinate lighting control loads specified in this Section with components providing overcurrent protection as specified in Division 26 Section "Panelboards."

1.8 LABELING

- A. Ethernet Taps and DMX devices shall have Control Device Number (i.e. 'ET-5') clearly indicated with minimum 1/4" tall white on black characters on the faceplate. Label shall be centered above control port(s).
1. All faceplate labels shall be as shown on the QT-series Drawings and verified in Shop Drawings.
- B. Furnish and install removable adhesive labels for each Theatrical Control Device back box and rear of faceplate, indicating the Control Device Number (i.e. 'ET-5') and serial code to facilitate programming and commissioning.

1.9 DELIVERY

- A. The Lighting Control System Manufacturer shall coordinate delivery of all equipment with the Construction Manager and/or Electrical Contractor.
- B. If required by the Construction Manager or Electrical Contractor, equipment shall be delivered in a minimum of three (3) separate shipments that shall include:
1. Shipment #1: All items in which conduit is terminated which includes dimmer racks, panels, control station back boxes, etc.
 2. Shipment #2: All items in which wiring is terminated including control station faceplates, etc.
 3. Shipment #3: All items that are not required until system activation by the Lighting Control System Manufacturer's field service representative. This shall include dimmer modules, electronics modules, control consoles, gateways, monitors, cables, etc.
- C. Lighting Control System Manufacturer shall deliver all material to the job site suitably crated, packed, and protected, and bearing the manufacturer's identification label and the nomenclature of the product(s) found in each carton or crate.
- D. If, through no fault of the Owner, the timely completion of the work of this Section is imperiled, the Lighting Control System Manufacturer shall prevent or minimize any delay by shipping the required product to the job site by air freight, at no additional cost to the Owner.
- E. Bid price shall include full freight and insurance charges for all items to the job site.

1.10 QUALITY ASSURANCE

- A. Manufacturer: Minimum 10 years' experience in manufacture of architectural and theatrical lighting controls.

- B. Manufacturer's Quality System: Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.
- C. Source Limitations: Obtain lighting control and power distribution components through one source from a single manufacturer wherever possible. All components shall be furnished by the Integrator regardless of source.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with 47 CFR, Subparts A and B, for Class A digital devices.
- F. Comply with NFPA 70.

1.11 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two (2) years. Support shall include 24-hour telephone support with guaranteed callback time of less than one hour.
- B. Upgrade Service: Update software and firmware to latest version at Project completion. Install and program software upgrades that become available within two (2) years from date of Substantial Completion. Upgrading of software shall include operating systems where applicable. Upgrade shall include new or revised licenses for use of the software.
 - 1. Provide 30-day notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment, if necessary.

1.12 WARRANTY

- A. Lighting Control System Manufacturer agrees to make all repairs, including replacement of components and parts, made necessary due to defects in design, workmanship, and materials without additional cost to the Owner for a period of two (2) years from the date of acceptance of the completed system.
- B. In the event of a system failure during the warranty period, manufacturer agrees to send to the job the necessary field service technician(s) within twenty-four (24) hours of notification.
 - 1. Technician(s) shall remain on the job until all necessary repairs have been made and the system is operational to the satisfaction of the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design
 - 1. Subject to compliance with these specifications, the design basis networked lighting control system is Paradigm Control as manufactured by Electronic Theatre Controls of Middleton, Wisconsin. Contact:
 - a. Randy Pybas, Western Sales Manager – ETC

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- 1) 323-461-0216
 - 2) Randy.pybas@etconnect.com
 2. Basis of design for other system components includes:
 - a. Network Switches
 - 1) GigaCore 14R as manufactured by Luminex Network Intelligence of Hechtel-Eksel, Belgium.
 - b. Rack UPS units
 - 1) 5P1500R series from Eaton Corporation of Cleveland, OH
- B. Equal Manufacturers
 1. Subject to Division 01 Specifications, other manufacturers may submit for consideration as equal to the design basis manufacturer products. Submittals for consideration must show conformance to project Specifications and system design requirements.
 2. Final determination of suitability shall be at the discretion of the Specifier.
 3. Manufacturers pre-approved to bid subject to the above requirements and to this Specification include the following:
 - a. Philips Strand Lighting of Dallas, TX.
 - 1) Contact: Leonard Miller, North American Sales Manager
 - 2) 214 647 7985 – leonard.miller@philips.com
 - b. American Power Conversion, Inc. – Kingston, RI (Rack UPS)

2.2 LIGHTING CONTROL RELAY PANELS (LRP-##)

- A. General:
 1. Each relay panel shall consist of up to (48) network-controlled relays. System shall be UL listed and labeled.
 2. Relays shall be configured for single or dual pole load control as scheduled.
 3. Relays shall be remotely operated by network communication link.
 4. Relay panel shall have the capability to act as a standalone lighting control system with the following capabilities:
 - a. Internal Astronomical Time Clock for programmed events.
 - b. Accepts input from external button stations for recall of presets.
 - c. Signal arbitration to prioritize inputs by source (sACN, DMX, Preset Stations, Time Clock, etc).
 - d. Configurable loss-of-signal behavior including 'hold last look' and 'activate preset'.
 5. Relay panel shall be equipped with UL924 rated input for triggering emergency 'panic' preset.
 6. USB port for upload of configuration files and firmware updates.
- B. Physical:
 1. Cabinets and Enclosures: NEMA 1 enclosure sized to accept required relays. Surface mounted cover as required with captive screws in a hinged, lockable configuration.
 2. Interior: Interiors shall be provided with installed and tested relays and interface modules.
 3. Panel side-mount enclosure shall provide low voltage control interface between network and relays, compliant with partitioning requirements for separation of line and low voltage.
 4. Provide physical separators between relays fed by 120V and 277V circuits, as well as between relays fed by Normal and Emergency circuits, as noted on each panel's associated Relay Panel Schedule on QT-series Drawings.
- C. Electrical:
 1. Relays:

- a. Mechanically held latching relays, 20A or 30A tungsten and NEMA electronic ballast rated, as scheduled.
 - b. Rated for 50,000 ON/OFF cycles at full load.
 - c. Support #10 - #14 AWG solid or stranded wire.
 - d. 120V and 277V rated.
 - e. FCC approved for commercial use.
- D. Control Electronics:
 1. Control electronics shall be integral to the panel side enclosure, providing network and user interface for individual control of relays in panelboard.
 2. Configuration of network addressing shall be by means of digital graphical display interface or by network port. Status LEDs shall indicate presence of Power and DMX signal.
 3. Control and communication signals shall be accommodated by means of system network and DMX512 interfaces.
 - a. The system network interface shall serve as primary integrating means between the rack electronics and the lighting control network, and shall also support remote configuration, file storage, playback, and monitoring capabilities from other devices on the network.
 - b. There shall be at least one (1) optically isolated DMX512 input and one (1) optically isolated DMX512 output per panel.
 4. Furnish ride-through power supply to permit electronics to remain energized during short duration loss of power, such as during transfer to backup generator.
 5. Furnish 0-10v control interface card in each panel.
- E. Basis of Design
 1. Basis of Design for Lighting Control Relay Panels shall be:
 - a. Echo Feedthrough, as manufactured by Electronic Theatre Controls

2.4 LIGHTING CONTROL NETWORK AND INTERFACE

- A. General
 1. Furnish and install a complete lighting control network system, capable of supporting the specified dimming racks, lighting control panelboards and relay panels, stage lighting control console, architectural control stations, time and calendar schedules, and related network devices indicated on the drawings and in this Specification.
 2. The network shall use category 5e Ethernet distribution to communicate between control consoles, dimmer racks, nodes, and computers.
 3. Manufacturer specified wiring and topology shall be used to communicate with control stations, sensor devices and relay panels.
- B. Network Components
 1. Control processors
 - a. Furnish architectural processor as required to interface dimmer rack, lighting control relay panels, control stations, sensors, system I/O contacts, and any appurtenant devices or equipment required for system to function fully as intended. Processor shall provide necessary programming interface for setup and configuration of system and system components.
 - b. Furnish a second backup processor, which shall be configured as a redundant standby to the primary processor.
 2. Ethernet switches and patch bays
 - a. Switches shall have integral Power over Ethernet (PoE) following IEEE 802.3 standard.

- b. Furnish 10/100 Ethernet switches with port quantity as required for system, plus 25% spare for future expansion at each rack location.
 - c. Patch bays in port quantities as required for devices in system, plus 25% spare for future expansion at each rack location.
- 3. DMX signal splitters
 - a. ANSI/USITT E1.1-2008 compliant DMX512 opto-isolating splitters, in quantity and configuration of inputs and outputs as required for system.
 - b. All DMX signal cables terminating at the splitter location shall be outfitted with 5-pin XLR connectors or RJ45 connectors as necessary to permit user patching where required. This includes signals to DMX node receptacles, dimmers, and relay panels.
- 4. Equipment racks
 - a. Wall or floor mounted 19" equipment racks with mounting rails, hinged locking door, and sized to accommodate all required processing equipment including that indicated above. Furnish in quantities shown on drawings plus any additional required for complete system.
 - b. Each rack shall have minimum of one four-space contiguous blank section with cover plate for future equipment addition.
 - c. Each rack shall be furnished with a three-space pull out drawer for storage of manuals, patch cabling, and user notes.
 - d. Racks shall be Middle Atlantic EWR series or equal.
 - e. Coordinate electrical power connections for rack contents.
- 5. Ethernet cabling
 - a. Ethernet cabling used in theatrical lighting control network shall have the following properties:
 - 1) Comply with NEMA WC-63.1 Category 5e, UL verified.
 - 2) Comply with TIA 568.C.2.
 - 3) Outer jacket shall be PURPLE in color.
 - b. Furnish and install RJ45 category 5 patch cables as necessary to fully patch between all network switch ports and patch bay ports in each rack location, plus 20% spares.
 - c. Furnish additional RJ45 category 5 patch cables to allow connection of distributed Ethernet taps to portable Ethernet-to-DMX gateways in the performance spaces. Refer to Theatrical Lighting Fixtures and Accessories Schedule on sheet QT5.06 for lengths and quantities to be furnished.
- 6. DMX network cabling
 - a. Furnish and install 5-pin XLR M/F DMX jumper patch cables as necessary to fully patch between all DMX-512 splitter ports and DMX patch points, racks, or other DMX devices at equipment racks.
 - b. Furnish additional 5-pin XLR M/F DMX jumper cables to allow connection of DMX node devices to portable dimmer bars, luminaires, and other devices in the performance spaces. Refer to Theatrical Lighting Fixtures and Accessories Schedule on sheet QT-502 for lengths and quantities to be furnished.
- 7. Ethernet taps
 - a. Mounting type as shown on drawings
 - b. Each tap with two (2) RJ45 Ethernet connectors, discretely fed from patch panel, unless noted otherwise.
- 8. Ethernet-to-DMX gateways/nodes
 - a. Mounting as shown on drawings, furnish with necessary hardware.
 - b. Each gateway/node with one, two, or four each 5-pin XLR connectors configurable for DMX512 input or output, or for ESTA/ANSI E1.20 two-way communication. Each connector may be addressed to discrete universes. Gateway/node universes shall be programmed to not overlap architectural lighting and wiring device universes.

- c. Surface mount gateways/nodes shall have Ethernet wire feed from patch panel to device.
- d. Portable gateways/nodes shall have one (1) RJ45 Ethernet connection to permit patching into any Ethernet tap shown on drawings. Each shall be outfitted with black Light Source MAB mega clamp or equal aluminum pipe clamp and black safety cable.
- e. Refer to drawings and schedules for quantity of each gateway/node type to be furnished.
- 9. Emergency signal overrides
 - a. Furnish UL924 listed emergency signal override devices that shall drive selected DMX addresses to full output when triggered by loss of normal power or by contact closure from fire alarm control panel. Override device shall be an ETC model DEBC or equal. Quantity as necessary to serve each DMX universe and fixture group that is served from Emergency lighting branch.
 - b. Refer E-series drawings for emergency lighting requirements for architectural fixtures.
- 10. Input/Output devices for communication with other systems
 - a. Furnish RS-232 communication interface for connection with audio-visual network.
 - b. Furnish dry contact closures configurable as input or output signals, to connect with fire alarm system, effects controls, shading systems, and future interfaces. Confirm all system contacts in shop drawings.
 - c. Furnish BACnet-over-IP interface device to permit future communication between Building Automation System and Lighting Control System.

2.5 STAGE LIGHTING CONTROL CONSOLES

- A. Black Box Theater lighting control console (LCC-1):
 - 1. Consoles shall be the following:
 - a. Electronic Theatre Controls – Ion 20 Xe series.
 - 2. Consoles shall have the following minimum capabilities:
 - a. 2,048 outputs
 - b. Configurable encoders for intelligent lighting attributes
 - c. DVI monitor output
 - d. USB ports for data storage and accessory connections
 - e. Remote focus connection
 - f. Ethernet port for network connection
 - g. DMX-512 ports for at least (2) universes
 - h. Offline programming software for Macintosh or Windows.
 - 3. The following accessories shall be furnished with the control console:
 - a. (2) 21" multi-touch monitors with power supply and control cables.
 - b. USB keyboard and mouse.
 - c. (2) commercial grade USB flash drives for backup storage, minimum 1Gb each.
 - d. (1) 25' RJ45 Ethernet control cable for connection of console to network taps.
 - e. (1) 50' RJ45 Ethernet control cable for connection of console to network taps.
 - f. (2) 25' DMX control cables, 5-pin male XLR to 5-pin female XLR, for backup DMX connection to network DMX ports.
 - g. Dust covers for console and monitors.
 - h. (1) Fortress 0520-0750-RUB or equal uninterruptible power supply.
 - 4. Furnish all power and interface devices, cabling, and accessories necessary for a fully functioning system.
 - 5. Rolling Cart
 - a. Provide wheeled console cart with brakes, of sufficient size to hold all components related to this console.

- b. Cart shall be of metal construction, painted black.

2.6 ARCHITECTURAL LIGHTING CONTROL STATIONS

- A. Stations shall serve as user interface to recall and manipulate common room lighting presets via the lighting control network.
- B. Pushbutton stations shall have quantity of buttons / faders as scheduled.
- C. LCD Touch-screen stations
 1. Stations shall be minimum 16-bit color with resolution of minimum 600x360.
 2. Stations shall have auto-fade with adjustable time out and shall adjust brightness proportionally to room ambient light levels.
 3. Station programming shall support up to (10) discrete screen shots configurable for preset recall, virtual faders, clock and time scheduling functions, dynamic color wheel for LED fixture color selection, and group selection and assignment.
 4. Station shall be configured with code lockout on home page.
- D. Stations shall operate on low voltage network bus as specified by Manufacturer, and shall be programmable via this network. Separate control device programming in Black Box Theater / Commons/Presentation Arena from control device programming in Broadcasting/TV Studio.

2.7 NETWORK OCCUPANCY / PHOTOCELL SENSORS

- A. Sensors
 1. Sensor shall be low-voltage type with 24vdc normally closed contacts to permit series installation of sensors on a contact loop home-run to lighting control network panel. Refer Electrical for device locations and quantities.
 2. Sensors shall be powered by a power supply transformer approved by Manufacturer, with class 2 output not to exceed 24vdc and 1A current. Supply shall be located in accessible area near sensors, and fed from unswitched power source.
 3. Sensors shall be PIR passive infrared type, with rectangular corridor coverage pattern and sensitivity to half-step walking motion at minimum 25 foot distance from sensor. Sensor shall detect 6-inch movement of any portion of a body presenting a target of at least 48 square inches to the sensor at this distance.
 4. Sensors shall be mounted on junction box at elevation shown on drawings. Orient sensor head to provide maximum coverage of corridor.
 5. Coordinate sensor placement to avoid false detection from supply air diffusers in vicinity.
 6. Mask sensors as necessary to avoid nuisance detection from adjacent areas when doors are left open.
 7. Provide timed override for sensors at LCD Touch-screen architectural master stations so sensors do not activate lighting functions during performances. Override shall time out after number of hours to be determined by Owner during programming in the event user does not restore override after performance ends.

PART 3 - EXECUTION

3.1 EXECUTION

- A. Verify that surfaces are ready to receive work.
- B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts existing conditions.
- E. Install in accordance with manufacturer's instructions and approved shop drawings.
- F. All wiring shall be installed in conduit.
- G. All branch load circuits shall be live tested before connecting the loads to the lighting control panels.

3.2 SUPPORT SERVICES

- A. System Startup
 - 1. Upon completion of installation, Contractor shall notify the Lighting Control System manufacturer that the system is ready for formal checkout and programming. No power shall be applied to the Lighting Control System unless specifically authorized by written instructions from the manufacturer.
 - 2. Manufacturer shall provide Factory-Authorized Technician to confirm proper installation and operation of all system components.
- B. Testing
 - 1. System shall undergo complete functional testing by a Factory-Authorized Technician. All loads shall be tested live for continuity and freedom from defects and all control wiring shall be tested for continuity and connections prior to energizing the system components.
 - 2. Contractor shall be responsible for correction of any improper wiring or component installation as identified by the Factory-Authorized Technician during testing. Contractor shall be responsible for any return visits by Factory-Authorized Technician resulting from lack of system readiness for checkout or from any incomplete or incorrect wiring or installation.
- C. Initial Programming
 - 1. Programming of initial button assignments, touch screen page layouts, normal and emergency presets, control priorities, sensor settings, time clock events, etc, shall be performed by a Factory-Authorized Technician. Consultant shall provide instructions for initial programming at request of Factory-Authorized Technician; however, all final decisions regarding programming shall be at the direction of the Owner.
 - 2. Programming and addressing of architectural lighting fixtures by Electrical Contractor. Information on the addressing of architectural lighting fixtures shall be provided to Factory-Authorized Technician as coordination drawing at time of shop drawings.

3.3 OWNER TRAINING

A. General

1. Manufacturer's authorized technician shall perform Owner Training.
2. Class size is limited to twelve (12) participants and shall include at minimum:
 - a. Owner shall provide a list of participants by title. For example, 'Technical Director, Master Carpenter, Master Electrician, etc.' To facilitate scheduling, include only mandatory participants on this list. Attendees not on the list will still be permitted to attend.
3. The Lighting System Integrator shall schedule instruction with the Owner's designated representatives. Agenda shall be sent in advance. All O&M materials, as designated in this Specification, shall be available at the time of training.
4. Instruction shall not necessarily follow immediately after the system check-out and activation.
5. Instruction shall be independent of the system check-out and activation. Length of engineering check-out and activation shall not affect the length of instruction time.
6. At Owner's discretion, instruction may occur in multiple time blocks.
7. Written documentation of Owner training shall be provided to the Owner upon completion.
 - a. Form to include:
 - 1) The date, time, and location of training.
 - 2) Name, title, company and signature of trainer.
 - 3) Name, title, and signature of all participants.
 - 4) Topics covered at training.
 - b. If training is non-continuous, provide one form for each training segment.
8. Training may be video and audio recorded by the Owner at the Owner's expense.

B. Up to twenty-four (24) hours of Owner training to include the following:

1. Minimum of three (3) separate training sessions with Owner, as follows:
 - a. First session shall occur at conclusion of startup and system commissioning and shall include eight (8) hours training time with Owner representatives. This session shall include the following general subjects, but shall be tailored to Owner's preference at time of training:
 - 1) General system overview.
 - 2) Routine care and maintenance.
 - 3) Operation of dimmer racks and relay panels.
 - 4) House Light Station operation and configuration, including review of initial programming provided by Consultant.
 - 5) Lighting Control Console introduction and basic programming
 - 6) Review of warranty and software updates
2. Second session shall occur no less than two weeks following substantial completion, but within one month of initial training. This session shall include up to an additional eight (8) hours training time with Owner representatives. This session shall include the following general subjects, but shall be tailored to Owner's preference at time of training:
 - a. In-depth Lighting Control Console operation and programming.
 - b. House Light Station preset review and adjustment to reflect actual operational needs.
 - c. Other review as requested by Owner.
3. Third session of additional eight (8) hours training time shall occur no less than one month after substantial completion, but within three months of initial training. Format and timeline shall be similar to the second session.

END OF SECTION 11 61 19

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SECTION 11 61 23 – STAGE DRAPERY

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. Inherently flame resistant velour house curtain with 75% fullness on bi-parting curtain track.
 - 2. Inherently flame resistant velour legs, sewn flat.
 - 3. Inherently flame resistant velour tabs, sewn flat, on “walk-along” curtain track.
 - 4. Inherently flame resistant seamless sharkstooth black scrim.
 - 5. Seamless, bleached IFR muslin cyc.
- B. It shall be the responsibility of the Stage Drapery Manufacturer to furnish equipment complete in all respects and to provide any additional equipment required to fulfill the intent of these drawings and specifications regardless of whether or not such items are herein specified or indicated.

1.3 SUBMITTALS

- A. Submittals shall be according to the Conditions of the Contract and Division Specification Sections.
- B. Prior to fabrication, Stage Drapery Manufacturer shall submit for review a 1/2 yard x full width minimum size sample of each color of each fabric type.
 - 1. Each sample shall be provided with labels listing Manufacturer and Manufacturer's identification numbers.
 - 2. Work shall not commence on fabrication until review of samples has been transmitted to the Stage Drapery Manufacturer.
 - 3. Submit Manufacturer's color line samples to the Specifier to verify color selections.
 - a. Dye lot to be guaranteed by Manufacturer.
 - 4. For custom color drapery, submit Manufacturer's lab dip sample matching control sample furnished by Architect.
 - a. Lab dip dye lot to be guaranteed and maintained by Manufacturer after approval.
- C. Prior to providing shop drawings and fabrication, dimensions shall be verified by field measurements.
 - 1. After field measurements are taken, Stage Drapery Manufacturer shall provide information as to exact dimensions of drapery items and areas affecting drapery sizes.
 - 2. This information will be used to coordinate work with other trades and to verify that all drapery items have been accounted for.

3. No extras will be allowed due to the Stage Drapery Manufacturer's misunderstanding as to the amount of work involved or lack of knowledge of any field conditions based on neglect or failure to make field measurements or thorough investigation of the job site.
- D. Shop Drawings shall be submitted for review before fabrication can begin. Such review does not relieve the Stage Drapery Manufacturer of the responsibility of providing equipment in accordance with this Specification.
 1. Shop Drawings shall show each type of curtain track plus the method and equipment to be used in hanging the curtain track.
 2. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from drawings.
 3. Where welded connections, concrete or masonry inserts are required to receive work, shop drawings shall show exact locations required and all such drawings shall be furnished to the trades responsible for installing the connectors or inserts.
 4. Catalog work sheets showing illustrated cuts of items may be submitted for standard manufactured items.
 - a. Furnish Operations and Maintenance manuals containing "record" shop drawings, operation instructions and recommended maintenance procedures for all equipment, in quantity outlined in Division 01.

1.4 DRAPERY MANUFACTURERS

- A. Manufacturers for work in this section shall include the following:
 1. Beck Studios, Inc – Milford, OH
 2. BellaTEX Stage Curtains – Jackson, TN
 3. iWeiss, Inc. – Fairview, NJ
 4. Rose Brand West – Sun Valley, CA
 5. Stage Decoration and Supplies – Greensboro, NC
 6. Tiffin Scenic, Tiffin, OH

1.5 INSTALLATION CONTRACTORS

- A. The Stage Drapery Contractor shall have been continuously engaged in the installation of stage drapery for at least ten (10) years.
- B. The Stage Drapery Contractor shall have installed a total of not less than five (5) installations of equal or greater scope to system specified herein, manufactured and installed by the bidder.
- C. Stage Drapery Contractors for Work of this Section shall include:
 1. Beck Studios Inc.; Milford, OH
Contact: Dan Ilhardt dan@beckstudios.net 513-831-6650
 2. Chicago Flyhouse; Chicago, IL
Contact: Benjamin Cohen bcohen@flyhouse.com 773-533-1590
 3. I. Weiss; Fairview, NJ
Contact: Jennifer Tankleff JenniferT@iweiss.com 888-325-7192
 4. J.R. Clancy, Inc.; Syracuse, NY
Contact: Mike Murphy mikemurphy@jrclancy.com 800-836-1885
 5. Texas Scenic; San Antonio, TX
Contact: Roy Harline r.harline@texasscenic.com 800-292-7490
 6. Tiffin Scenic Studios; Tiffin, OH
Contact: Steve Everhart severhart@tiffinscenic.com 800-445-1546

- D. The Contractor for this section shall be the same Contractor that furnishes and installs the following related Division 11 theatrical systems specified on this project:
1. 11 61 23 – Pipe Grids and Dead-Hung Rigging

1.6 DELIVERY

- A. Refer to Division 01 – Work-Related Requirements for transporting, handling, storing, and protecting products.
- B. Bid price shall include full freight and insurance charges for the delivery of all drapery items to the job site.
- C. If, through no fault of the Owner, the timely completion of the work of this section is imperiled, the Drapery Manufacturer shall prevent or minimize any delay by shipping the required products by airfreight, at no additional cost to the Owner.
1. This requirement covers initial delivery of fabrics to the Drapery Manufacturer, and delivery of finished drapery to the job site.
- D. Each drapery item shall be carefully wrapped and sealed tight for shipment in rigid and waterproof wrapping material to insure against impact and water damage during shipment.

1.7 WARRANTY

- A. Manufacturer agrees to make all repairs, including replacement of materials, made necessary due to defects in workmanship and materials without additional cost to the Owner for a period of two (2) years from the date of acceptance.

PART 2 - PRODUCTS

2.1 STAGE DRAPERY

- A. FABRICS
1. All fabrics shall be inherently flame retardant and shall meet all requirements set forth in NFPA #701, Large and Small Scale.
 - a. All finished goods shall be furnished by the Stage Drapery Manufacturer to the Owner with proper affidavit of flame proofing in the form acceptable to local authorities.
 - b. The following fabrics are approved for drapery use:
 - 1) House curtain panels, legs, and tabs shall be in manufacturer standard colors to be selected by Specifier, using following fabric:
 - a) Encore, 22 oz. 100# IFR Poly, 54" wide, supplied by KM Fabrics, Greenville, SC.
 - 2) Cyclorama shall be white in color, seamless, IFR.
 - 3) Scrim shall be black or white IFR sharkstooth, seamless, as scheduled.

2.2 TIE LINE, GROMMETS, WEBBING

- A. Grommets shall be #2 or #3 brass type.

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- B. Tie lines shall be #4 braided masonry line, 36" long and black in color, unless otherwise noted.
- C. Webbing shall be 3" wide, polypropylene type.
- D. Hook / Loop tape fasteners shall be 1.5" sew-on industrial grade, black finish. Velcro Brand #190607/190650 or equal.

2.3 DRAPERY

- A. General:
 - 1. All velour shall be stitched with nylon thread and shall be without flaws, with each width of cloth continuous for the full height of the drapery with no horizontal seams or piercing.
- B. Velour Bi-Part Curtain Panels:
 - 1. Each panel shall be sewn with vertical seams and fullness as noted on drapery schedule. Panels shall be lined with 56" IFR 100% polyester Avora Lining in black. Sew into webbing and side hems. Tack at seams.
 - 2. Sew on to webbing 12" o.c. with snap hooks attached with nylon straps and two (2) rivets per hook.
 - 3. Provide onstage and offstage turnbacks as noted on schedule. Turnbacks shall be sewn into face panel along bottom pocket hem, with vertical edge of turnback aligned to a panel seam for vertical stitching to prevent billowing of turnback.
 - 4. Bottom hem as scheduled.
- C. Velour Legs and Tabs:
 - 1. Each panel shall be sewn with vertical seams and fullness pleated in as noted on drapery schedule.
 - 2. Sew onto webbing with grommets at 12" o.c. with tie lines attached for each.
 - 3. In addition to tie lines, sew on to webbing 12" o.c. with snap hooks attached with nylon straps and two (2) rivets per hook.
 - 4. Provide side turnbacks as noted on schedule.
 - 5. Bottom hem as scheduled.
- D. Sharkstooth Scrim:
 - 1. Scrim shall be made up of seamless sharkstooth scrim material in color noted on drapery schedule.
 - 2. Sew scrim onto webbing at the top and face the scrim with a piece of 3" wide #8 canvas sewn through the scrim to the webbing with grommets at 12" o.c., furnished with tie lines.
 - 3. In addition to tie lines, sew on to webbing 12" o.c. with snap hooks attached with nylon straps and two (2) rivets per hook.
 - 4. Scrim to have a 6" hem which acts as a "flap" to mask pipe and chain pockets.
 - 5. Bottom hem as scheduled.
 - 6. Extend scrim material over front of hem to create a masking flap that touches floor.
 - 7. At each side of the scrim, provide a 4" reinforced turn back hem.
- E. Cyclorama Panels:
 - 1. Cyclorama shall be sewn from IFR seamless muslin, dyed to CBS gray color.
 - 2. In addition to tie lines, sew on to webbing 12" o.c. with snap hooks attached with nylon straps and two (2) rivets per hook.
 - 3. Cyc panel to have a 6" hem which acts as a "flap" to mask pipe and chain pockets.
 - 4. Bottom hem as scheduled.
 - 5. Extend scrim material over front of hem to create a masking flap that touches floor.
 - 6. At each side of the scrim, provide a 4" reinforced turn back hem.

2.4 DRAPERY SCHEDULES

- A. Refer to QT series drawings for drapery panel schedule indicating quantity, width, height, and type.
- B. Drapery Manufacturer shall field verify all dimensions prior to fabrication. Any errors in finished size due to failure to properly verify field conditions will result in re-manufacture of any draperies not in compliance, at sole expense of the Manufacturer.
- C. Labeling of each drapery panel shall be by means of a cotton or synthetic duck tag sewn securely to the webbing at top right hand corner of each finished piece. Each tag shall contain the following, marked using indelible black ink:
 - 1. Type of panel (ex: Leg, Traveler #1 S.R., etc.)
 - 2. Panel dimensions (ex: 8'-0"w x 24'-0"h)
 - 3. Material type and weight (ex: 25oz IFR Velour)
- D. Border, Scrim, and Cyclorama panels shall have the panel center line indelibly marked on the top rear webbing, and shall have a contrasting color center tie line.

2.5 CURTAIN TRACKS

- A. Bi-Parting Traveler Drapery Curtain Tracks:
 - 1. Furnish and install all hardware required for cord operated ADC #282 or H&H #416S curtain track system in lengths and locations as shown on the drawings.
 - a. Track shall be furnished in minimum 14 gauge galvanized steel construction.
 - b. Equip with backpack/rear fold devices for offstage curtain gathering.
 - 2. System shall be suspended from structure as indicated on drawings, in a manner that permits adjustment of height as well as simple re-positioning of the system when required for various productions.
 - 3. Track shall be in a continuous straight length, with minimum number of segments joined to complete the lengths indicated.
 - 4. Support tracks from suspended pipe battens or from building structure at manufacturers recommend spacing as required.
 - 5. System shall be furnished complete with all necessary accessories (CWANA), including factory curves (trim to adjust as required), hanging clamps, track splices, master carriers, single carriers, rubber bumpers, center pipe supports, and end stops for all tracks.
 - a. Furnish adequate carriers to serve number of drapery grommets indicated for drapery scheduled for each track system, plus 10% spare carriers.
- B. Walk Along Curtain Tracks:
 - 1. Furnish and install all hardware required for walk along ADC #143 or H&H #301W curtain track system in lengths and locations as shown on the drawings.
 - 2. System shall be suspended from structure as indicated on drawings, in a manner that permits adjustment of height as well as simple re-positioning of the system when required for various productions.
 - 3. Track shall be in a continuous straight length, with minimum number of segments joined to complete the lengths indicated. Provide curves as shown on drawings.
 - 4. Support tracks from suspended pipe battens or from building structure at maximum spacing shown on the drawings. Additional supports required at each track bend location.
 - 5. System shall be furnished complete with all necessary accessories (CWANA), including factory curves (trim to adjust as required), hanging clamps, track splices, master carriers, single carriers, rubber bumpers, and end stops.

- a. Furnish adequate carriers to serve number of drapery grommets indicated for drapery scheduled at each track system, plus 10% spare carriers.
- C. Verify all track lengths in the field before fabrication.

2.6 ACCESSORIES

- A. Furnish 1/2" NPS schedule 40 steel pipe or 3/4" IMT conduit, threaded and coupled, for use as curtain panel bottom stretcher.
 - 1. Provide four (4) 8'-6" lengths.
 - 2. Provide one (1) end cap and (1) pipe coupler for each pipe segment, to protect fabric during insertion of pipe and to permit joining of segments.
- B. Furnish quantity of two (2) 16 bushel rolling storage hampers with canvas liner and plywood hinged lid, for storage of stage drapery when not in use.
 - 1. Liner shall be heavy duck canvas, plain white color, sewn onto frame with top reinforcement. Fabric loop handles shall be sewn at each end of liner.
 - 2. Hamper frame shall be spring steel, welded to bottom plate steel.
 - 3. Chassis shall be hardwood runners with caster boards.
 - 4. Casters shall be 4" diameter swiveling with rubber or phenolic treads.
 - 5. Basis-of-Design Manufacturer: Dandux by C. R. Daniels Inc.

PART 3 - EXECUTION

3.1 GENERAL

- A. Examine all conditions under which all items in the section shall be installed and notify the Construction Manager in writing of any condition detrimental to the proper and timely completion of the installation.
- B. Responsibility for the satisfactory completion of the work in this section shall rest solely and exclusively with the Stage Drapery Manufacturer.
- C. Field verify condition of delivered goods, and repair or replace any components not in factory new condition. All materials shall remain covered or protected from debris, dust, paint, and other site hazards throughout the period between delivery to site and Owner training.
- D. Manufacturer shall be responsible for repairing any damage to jobsite surroundings during installation.
- E. Installation and training shall be supervised by the Stage Drapery Manufacturer's experienced supervisor, who shall have extensive installation experience with systems similar to those specified herein. This same supervisor shall remain in charge throughout the entire installation and training process, with exception only for circumstances completely beyond the control of the Manufacturer.
- F. All components shall be installed plumb, straight, and true, and shall function as designed. Anchors, connecting members, brackets, and associated fastening means and methods for properly supporting and bracing equipment shall be furnished and installed following best suitable practice for each condition.

- G. Prior to the completion of the installation, the Stage Drapery Manufacturer shall notify the Construction Manager to arrange on a date for inspection of the system.
 - 1. At the time of the inspection, the Stage Drapery Manufacturer shall furnish sufficient personnel to operate all equipment and to perform adjustments and tests as may be required by the Owner's representatives.
 - 2. Any equipment that fails to meet with the Specifications shall be repaired or replaced with new equipment, and the inspection shall be re-scheduled under the same conditions listed previously.
 - 3. Final review will be withheld until all systems have been thoroughly tested and found to be in first class operating condition in every circumstance.

3.2 OWNER TRAINING

- A. Manufacturer's installation Supervisor shall perform up to four (4) hours of Owner training to the Owner's representatives.
- B. Training shall include:
 - 1. Operation of curtain tracks and switchers.
 - 2. Installation, dismantling, and storage of draperies.
 - 3. Care and maintenance.
 - 4. Warranty review.
- C. Class size is limited to 6 participants/crew and shall include at minimum:
 - 1. Technical Director
 - 2. Scene Shop Supervisor
- D. Contractor shall schedule instruction with the Owner's designated representatives.
- E. Instruction shall be independent of the system check-out and activation. Length of engineering check-out and activation shall not affect the length of instruction time.
- F. Written documentation of Owner training shall be provided to the Owner upon completion.
 - 1. Form to include:
 - a. The date, time, and location of training.
 - b. Name, title, company and signature of trainer.
 - c. Name, title, and signature of all participants.
 - d. Topics covered at training.
 - 2. If training is non-continuous, provide one form for each training segment.
- G. Training may be video and audio recorded by the owner at the owner's expense.

END OF SECTION 11 61 23

SECTION 11 61 33 – PIPE GRID

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 all labor, materials, equipment, and services necessary to furnish and install the pipe grid and dead-hung pipes as shown on the drawings and/or specified herein.
- B. It shall be the responsibility of the Pipe Grid Contractor to furnish equipment complete in all respects and to provide any additional equipment required to fulfill the intent of these drawings and specifications regardless of whether or not such items are herein specified or indicated.

1.3 PROJECT CONDITIONS

- A. All dimensions shall be verified in the field prior to fabrication by the Pipe Grid Contractor, who shall make at least one (1) visit to the job site prior to preparation of shop drawings.
- B. No extras will be allowed due to the Pipe Grid Contractor's misunderstanding of the work involved or its lack of knowledge of any field conditions due to failure to make accurate field measurements or a thorough investigation of the job site.

1.4 SUBMITTALS

- A. Pipe Grid Contractor shall prepare and submit complete shop drawings according to the requirements set forth in the Contract Documents.
- B. Shop Drawings shall be submitted for review by the Architect before fabrication can begin. Such review does not relieve the Pipe Grid Contractor of the responsibility of providing equipment in accordance with this Specification.
- C. Shop Drawings:
 - 1. Shop Drawings shall show dimensions, sizes, gauges, thicknesses, finishes, joining, attachments and relationship of work to adjoining construction.
 - 2. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from drawings.
 - 3. Where other materials must be set to exact locations to receive pipe grid, furnish assistance and directions necessary to permit other trades to locate their work.
 - 4. Where welded connections, concrete or masonry inserts are required to receive work, shop drawings shall show exact locations required.
 - 5. Catalog work sheets showing illustrated cuts of items may be submitted for standard manufactured items.

- D. The Contractor shall, if requested by the Owner or Architect, furnish satisfactory evidence as to the kind and quality of materials he proposes to furnish by submission of exact samples of hardware to be used in this contract.
- E. Upon completion of installation, Pipe Grid Contractor shall provide Operation and Maintenance manuals that shall include "record" shop drawings, parts lists, operational instruction, service/maintenance recommendations, component working load limits, etc.
 - 1. One (1) O&M manual shall be a printed "hard" copy.
 - 2. O&M manual shall also be provided in electronic format on two (2) flash drives.
- F. Rigging System Log Book:
 - 1. At Owner training, furnish a system log book, configured to permit Owner tracking of inspections, system issues and maintenance history. Provide overview of observations and actions that should be documented for appropriate record keeping and compliance with industry standards for safety. Log book shall include:
 - a. Schedule and ID of all installed rigging equipment.
 - b. Identification of design parameters for each pipe, including trim limits, set live loading capacity, etc.
 - c. Log sheet for periodic system-wide inspections, including commissioning date of system as first entry.
 - d. Journal fields for each set to document date, status, observations, actions taken, and resolution.

1.5 INSTALLATION CONTRACTORS

- A. The Pipe Grid Contractor shall have been continuously engaged in the installation of theatrical stage rigging equipment for at least ten (10) years.
- B. The Pipe Grid Contractor shall have installed a total of not less than five (5) installations of equal or greater scope to system specified herein, manufactured and installed by the bidder.
- C. Pipe Grid Contractors for Work of this Section shall include:
 - 1. Beck Studios Inc., Milford, OH
Contact: Dan Ilhardt dan@beckstudios.net 513-831-6650
 - 2. J.R. Clancy, Inc., Syracuse, NY
Contact: Mike Murphy mikemurphy@jrclancy.com 800-836-1885
 - 3. Clearwing Productions Arizona, Phoenix, AZ
Contact: Jill Maurer jmaurer@clearwing.com 602-850-6333
 - 4. LVH Entertainment Systems, Los Angeles, CA
Contact: Kevin Kish kkish@lvhent.com 805-278-4584
 - 5. Mainstage Theatrical Supply, Pensacola, FL
Contact: Dean Sternke dsternke@mainstage.com 850-434-2080
 - 6. Sapsis Rigging Inc., Primos, PA
Contact: Bill Sapsis bill@sapsis-rigging.com 800-727-7471
 - 7. Stagecraft Industries Inc., Portland, OR
Contact: Kevin Shetterly kevins@stagecraftindustries.com 503-286-1600
 - 8. Texas Scenic Co., San Antonio, TX
Contact: Roy Harline r.harline@texasscenic.com 800-292-7490
 - 9. Tiffin Scenic Studios, Tiffin, OH
Contact: Steve Everhart severhart@tiffinscenic.com 800-445-1546
 - 10. I. Weiss, Fairview, NJ
Contact: Jennifer Tankleff JenniferT@iweiss.com 888-325-7192

PIPE GRID

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- D. The Contractor for this section shall be the same Contractor that furnishes and installs the following related Division 11 theatrical systems specified on this project:
1. 11 61 23 – Stage Drapery

1.6 DELIVERY

- A. Refer to Division 01 – Work-Related Requirements for transporting, handling, storing, and protecting products.
- B. Bid price shall include full freight and insurance charges for the delivery of all equipment to the job site.
- C. If, through no fault of the Owner, the timely completion of the work of this section is imperiled, the Pipe Grid Contractor shall prevent or minimize any delay by shipping the required products by airfreight, at no additional cost to the Owner.
- D. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.7 WARRANTY

- A. The Pipe Grid Contractor shall assure that the pipe grid is properly installed, free of defects in materials and workmanship and shall provide a warranty on all equipment and workmanship provided under this contract for a period of two (2) years from the date of the final acceptance.
- B. Post Installation Safety Inspection:
1. One year after the date of final acceptance by the Owner, the Pipe Grid Contractor Supervisor shall return to the job site to conduct a thorough inspection of the rigging installation.
 - a. All bolts shall be checked and tightened as required, cables and all cable connections inspected and all items given a thorough safety inspection in compliance with ANSI E1.47, Entertainment Technology – Recommended Guidelines for Entertainment Rigging System Inspections.
 - b. All damage not caused by negligence on the part of the Owner shall be repaired and/or replaced.
 - c. If the original supervisor is unavailable either because the supervisor no longer works for the contractor or due to issues fully beyond the control of the contractor, then an alternate rigger superintendent shall perform the inspection, under the following conditions:
 - 1) The alternate superintendent shall be ETCP-RT certified.
 - 2) The alternate superintendent shall have experience supervising installation on projects of similar scope and scale.
 2. All materials, superintendent labor, transportation and living expenses for this work shall be furnished by the Pipe Grid Contractor at no additional cost to the Owner.
 - a. The inspection and repair work shall be conducted during normal working hours at a time mutually agreed upon by the Owner and the Pipe Grid Contractor.
 3. Within two (2) weeks of the completion of the inspection, the Pipe Grid Contractor shall provide the Owner and Architect with a written report stating the findings of the inspection.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Ferrous materials and accessories shall conform to the following ASTM and ANSI standard specifications:
 - 1. Standard structural steel shapes and plates: ASTM A-36.
 - 2. Miscellaneous steel items: ASTM A-283, grade optional.
 - 3. Steel pipe: ASTM A-120
 - 4. Gray iron castings: ASTM A-48, Class 30 unless otherwise specified.
 - 5. Malleable iron castings: ASTM A-47
 - 6. Bolts and nuts: B18.2.1&2
 - 7. Welding electrodes shall be as permitted by AWS Code D1.0.
- B. Wire Rope and Fittings
 - 1. Wire rope shall be 1/4" 7x19 construction, utility cable that meets Federal Specification RR-W-410E.
 - a. Damaged or deformed cables shall not be used.
 - 2. Cable fittings shall be Nicopress copper sleeves and conform to wire rope manufacturer's recommendations as to size, number and method of installation.
- C. Aluminum Materials and Accessories
 - 1. Thicknesses, gauges and tempers of aluminum products shall be as required for proper forming operations and to meet structural standards.
 - 2. Aluminum Castings: 214 or 356 alloy as per strength requirements.
 - 3. Fasteners: Include bolts, nuts, washers, screws, nails, rivets and other fastenings necessary for proper erection and/or assembly of aluminum work.
 - 4. Fabrication shall be by AWS certified welders.
- D. Finishes For Items Without Factory Finish
 - 1. Welds, burrs and rough surfaces on all interior ferrous metals shall be ground smooth and the completed assembly cleaned and all metal surfaces shall be given a minimum one coat of finish paint.
 - 2. All exposed fastenings shall match color and finish of adjacent material.

2.2 SAFETY STANDARDS

- A. In order to establish minimum standards of safety, the following factors shall be used:
 - 1. Cables and fittings 8:1 Safety Factor
 - 2. Terminating hardware: 5:1, or not exceeding WLL, whichever is more restrictive.
 - 3. Steel: 1/5 of yield
 - 4. Bolts: Grade 5 or better, plated

2.3 PIPE GRID

- A. Pipe grid shall be constructed of 1-1/2" NPS schedule 40 steel pipe as shown on the drawings. Pipe grid and all mounting hardware shall be painted black.

PIPE GRID

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- B. All joints shall be sleeve spliced with 18" long sleeves with 9" extending into each pipe and held by two hex bolts and lock nuts on each side of the joint.
- C. Grid shall be installed with pipes intersecting on centers shown on the drawings.
 - 1. All intersections shall be connected using a right angle or variable angle intersection clamps as required.
 - 2. Intersection clamps shall be made of two minimum 1/8" thick, painted steel plates formed to grip 1-1/2" NPS schedule 40 pipes at right angles.
 - 3. Intersection clamps shall be complete with four 3/8" x 1" hex bolts with lock nuts.
 - 4. Intersection clamps shall have a recommended working load of at least 1500#.
- D. Each pipe shall terminate short of the walls. Wall plates shall allow the grid to be securely braced against the wall in locations shown on the drawings.
 - 1. U-bolts or two bolts and nuts shall be supplied to secure the pipe and the plate in position.
- E. The grid shall be hung from the building structure at locations shown on the drawings using 1/2" diameter all-thread rod ending in min. 6" x 1/2" forged turnbuckles attached to pipe clamps.
 - 1. At each point, the all-thread rod shall attach to the overhead steel with an appropriate fitting.
 - 2. Cables shall be formed over thimbles of correct size and fastened with Nicopress sleeves crimped three times.
 - 3. All turnbuckles shall be moused after final trimming of the pipe grid.
- F. Grid Loading shall be as follows:
 - 1. Unless noted otherwise on drawings, pipe grids shall be furnished with adequate hangers and anchorages to support a uniformly distributed load of 35 pounds per linear foot of pipe.
 - 2. Grid hangers and anchorages shall be designed to support no less than 450 pounds.
- G. Pipe grid shall hang plumb and level in all directions.

PART 3 - EXECUTION

3.1 GENERAL

- A. Examine all conditions under which all stage pipe grid items shall be installed and notify the Owner and Architect in writing of any condition detrimental to the proper and timely completion of the work.
- B. Responsibility for the satisfactory completion of this pipe grid shall rest solely and exclusively with the Pipe Grid Contractor.
- C. The Pipe Grid Contractor shall be responsible for storage of all equipment and tools during the period of installation and shall be responsible for collecting and removing from the job site all packing materials, trash, scrap materials, etc.
- D. The Pipe Grid Contractor shall be responsible for the protection of equipment and/or finished materials provided by other Contractors.

PIPE GRID

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3.2 INSTALLATION SUPERVISION

- A. Installation of the pipe grids shall be supervised by the Pipe Grid Contractor's own experienced superintendent having extensive experience in installing work of this kind.
 - 1. Superintendent shall be an Entertainment Technician Certification Program (ETCP) Certified Rigger - Theatre.
 - a. Rigging System Contractor shall provide the Architect with a copy of the superintendent's ETCP certification and shall make a copy of this certification available on the job site for the length of the installation.
 - 2. An ETCP Certified Rigger - Theatre shall be present at all times during the pipe grid installation.
- B. The same individual shall remain in charge of the work throughout the installation of the pipe grid until work is completed excepting only the intervention of circumstances completely beyond the control of the Pipe Grid Contractor.
- C. The superintendent shall represent the Pipe Grid Contractor and all directions given to him shall be binding as if given to the Pipe Grid Contractor.
 - 1. The Pipe Grid Contractor may require the Owner to confirm such directions in writing.

3.3 FIELD QUALITY CONTROL

- A. All equipment shall be installed in locations shown on Construction Drawings.
- B. Pipe grid shall be installed in accordance with OSHA Safety and Health Standards and all local codes. All welding shall be in full compliance with the most recent edition of the Structural Welding Code (ANSI / AWS D1.1).
- C. All components shall function as designed and be installed plumb, straight and true.
- D. The Pipe Grid Contractor shall do all drilling and fitting required in the setting of materials in place, and shall do all cutting and fitting required in connection with the fitting of his materials to the adjoining work of other Contractors.
- E. The Pipe Grid Contractor shall provide all connecting members, brackets, etc., as required for properly supporting and securing his work to the masonry, joints, walls, structural members, or other parts of the building as may be best suited for each condition.
- F. Install the pipe grid in locations shown on the drawings.

END OF SECTION 11 61 33

SECTION 11 66 23 - GYMNASIUM EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Safety pads.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include assembly, disassembly, and storage instructions for removable equipment.
- B. Shop Drawings: For gymnasium equipment.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of field assembly for removable equipment, connections, installation, mountings, floor inserts, and operational clearances.
- C. Samples: For each exposed product and for each item and color specified.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gymnasium equipment to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify position and elevation of wall supports and layout for equipment.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of equipment that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SAFETY PADS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Draper Inc; or a comparable product by, but not limited to, one of the following:
 - 1. Jaypro Sports, LLC.
 - 2. Performance Sports Systems.
 - 3. Porter Athletic Equipment Company.
- B. Source Limitations: Obtain from single source from single manufacturer.
- C. Flammability: Rated self extinguishing in accordance with California State Fire Code F-230.
- D. Surface-Burning Characteristics: Comply with ASTM E84; testing 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: 450 or less.
- E. Pad Coverings: Provide safety pad fabric covering that is fabricated from puncture- and tear-resistant, PVC-coated polyester or nylon-reinforced PVC fabric, minimum 14-oz./sq. yd. and treated with fungicide for mildew resistance; with surface-burning characteristics indicated.
- F. Wall Safety Pads: Padded wall wainscot panels designed to be attached in a continuous row; each panel section consisting of fill laminated to backer board, with visible surfaces fully covered by seamless fabric covering, free of sag and wrinkles and firmly attached to back of backer board.
 - 1. Backer Board: 7/16 inch urea-formaldehyde free Oriented Strand Board.
 - 2. Fill: 2 inches thick, flame retardant open cell neoprene foam with 6 pounds density.
 - 3. Size: Each panel section as indicated on Drawings.
 - 4. Number of Modular Panel Sections: As indicated on Drawings.
 - 5. Installation Method: Manufacturer's standard.
 - 6. Fabric Covering Color(s): Architect selection from Manufactures full range of colors.

- G. Cutout Trim: Manufacturer's standard flanged cutout trim kits for fitting pads around switches, receptacles, and other obstructions.
 - 1. Color: Black.

2.2 MATERIALS

- A. Softwood Plywood: DOC PS 1, exterior.
- B. Particleboard: ANSI A208.1.
- C. Equipment-Mounting Board: Wood, transparent or neutral-color-painted finish; size and quantity as required to mount gymnasium equipment according to manufacturer's written instructions.
- D. Anchors, Fasteners, Fittings, and Hardware: Gymnasium equipment manufacturer's standard corrosion-resistant or noncorrodible units; concealed; tamperproof, vandal- and theft-resistant design.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for court layout, alignment of mounting substrates, installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.
 - 1. Verify critical dimensions.
 - 2. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements are clearly marked. Locate reinforcements and mark locations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install gymnasium equipment after other finishing operations, including painting, have been completed unless otherwise indicated.
- B. Permanently Placed Gymnasium Equipment and Components: Install rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relationship to adjacent construction; and aligned with court layout.
- C. Anchoring to In-Place Construction: Use anchors and fasteners where necessary to secure built-in and permanently placed gymnasium equipment to structural support and to properly transfer load to in-place construction.

GYMNASIUM EQUIPMENT

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- D. Connections: Connect electric operators to building electrical system.
- E. Removable Gymnasium-Equipment Components: Assemble in place to verify that equipment and components are complete and in proper working order. Disassemble removable gymnasium equipment after assembled configuration is approved by Owner, and store units in location indicated on Drawings.

3.3 INSTALLATION OF SAFETY PADS

- A. Mount with bottom edge at 4 inches above finished floor.
- B. Cutout Trim: Limit cuts in face of padding so that cuts are securely and fully concealed behind trim-kit flange.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform visual inspections and operational tests as recommended by referenced standard rules of each sport and the equipment manufacturer.
- C. Gymnasium equipment will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 11 66 23

SECTION 11 90 00 - MISCELLANEOUS EQUIPMENT AND FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Hydrotherapy Whirlpools
- B. Related Requirements:
 - 1. 07 92 00 – Joint Sealants
 - 2. Division 22 – Plumbing
 - 3. Division 26 - Electrical

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For dance barre. Indicate layout including bracket spacing and anchorage details.
- C. Samples: For items where color or finish selection is required.

PART 2 - PRODUCTS

2.1 Hydrotherapy Whirlpools, Low Tank, Body.

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Whitehall Manufacturing, Morris Group International; model **L-90-S** or comparable product by one of the following:
 - 1. Ferno IIIe.
 - 2. Or Approved Equal
- B. Description: Stationary, extended-length, stainless steel tank for legs, hips, and lower back.
 - 1. Standard: CE IEC 60601-1.
 - 2. Material: 14 gauge Type 304 stainless steel.
 - 3. In "Finish" Subparagraph below, retain No. 4 finish for basis-of-design manufacturer's standard finish. Powder-coat finish is optional feature.
 - 4. Finish: No. 4, satin finish.
 - 5. Water Capacity: **90 gal. (341 L)**.

MISCELLANEOUS EQUIPMENT AND FIXTURES

11 90 00 - 1

6. Drain: NPS 2 (DN 50) combination drain and overflow.
7. One filler spout.
8. Controls: ON/OFF switch.
9. Thermometer: Dual-scale, tank mounted.
10. One electric turbine ejector, 1/2 hp (375 W).
11. Turbine Unit Electrical Characteristics:
 - a. Volts: 115 V.
 - b. Phase: One.
 - c. Hertz: 60.
 - d. **Full-Load Amperes: [6.9/6/2] [3.5/3.1] A.**
12. Accessories:
 - a. Mixing Valve: 15 gpm (57 lpm).
 - b. Separate drain and overflow assembly.
 - c. Ground fault circuit interrupter.
 - 1) Reclining seat.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install healthcare plumbing fixtures level and plumb in accordance with rough-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted fixtures.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install water-supply piping with stop on each supply to each fixture to be connected to water-distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 1. Exception for use of ball or gate valve if supply stops are not specified with fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
- D. Install traps on fixture outlets.
 1. Exception for omission of trap on fixtures with integral traps.

MISCELLANEOUS EQUIPMENT AND FIXTURES

11 90 00 - 2

- E. Set healthcare showers in leveling bed of cement grout.
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks.
- G. Seal joints between healthcare plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.
- H. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with requirements for water piping.

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Spec Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Spec Section "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning healthcare plumbing fixtures, fittings, and controls.
- B. Adjust water pressure to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.6 CLEANING AND PROTECTION

- A. After installing healthcare plumbing fixtures, inspect and repair damaged finishes.
- B. Clean healthcare plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

MISCELLANEOUS EQUIPMENT AND FIXTURES

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- C. Provide protective covering for installed fixtures and fittings.
- D. Do not allow use of healthcare plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 11 90 00

SECTION 12 24 13 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Manually operated roller shades with single rollers.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
- C. Samples: For each exposed product and for each color and texture specified, 10 inches long.
- D. Product Schedule: For roller shades.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.
- B. Basis-of-Design: Subject to compliance with requirements, provide the following or approved equal:
 - 1. Manual shades: Mecho/5 with silver snaploc fascia by Mechoshade Systems, Inc.
 - 2. Shadeband material:
 - a. Light-filtering fabric: ThermoVeil Basket Weave 1500 Series 3% open 2 by 2 dense basket-weave pattern.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 - 1. Bead Chains: Manufacturer's standard.
 - a. Loop Length: Full length of roller shade extend to within 48" AFF.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Clip, jamb mount.

ROLLER WINDOW SHADES

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2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.
 - a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.
- B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
- C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- E. Shadebands:
 1. Shadeband Material: as indicated.
 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.
- F. Installation Accessories:
 1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
 - a. Shape: L-shaped.
 - b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.
 2. Endcap Covers: To cover exposed endcaps.
 3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 SHADEBAND MATERIALS

- A. Shadeband material shall comply with requirements from California Building Code Chapter 8 (CBC 806.4).
- B. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.4 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

ROLLER WINDOW SHADES

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- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
 - 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
 - 2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
 - 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
 - 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.
- B. Roller Shade Locations: At all exterior windows.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

ROLLER WINDOW SHADES

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- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 12 24 13

SECTION 12 35 53.19 - WOOD LABORATORY CASEWORK

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. Wood laboratory casework.
2. Laboratory countertops.
3. Tables.
4. Laboratory sinks.
5. Laboratory accessories.
6. Safety cabinets.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for wood blocking for anchoring laboratory casework.
2. Section 09 65 13 "Resilient Base and Accessories" for resilient base applied to laboratory casework.
3. Section 11 53 13 "Laboratory Fume Hoods" for fume hoods.

1.3 REFERENCES

- A. ADA (ATBCB ADAAG): Americans with Disabilities Act Accessibility Guidelines.
- B. ANSI/AIHA 9.5: American National Standard for Laboratory Ventilation.
- C. ANSI/ASHRAE 110: Method of Testing Performance of Laboratory Fume Hoods.
- D. ANSI 2358.1: Minimum Performance Requirements for Emergency Showers.
- E. ASTM A167: Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- F. ASTM A 666: Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- G. Architectural Woodwork Institute (AWI): Quality Standards.
- H. FS W-C-596: Electrical Power Connector, Plug, Receptacle, and Cable Outlet.

- I. NEMA WD 1: General Color Requirements for Wiring Devices.
- J. NEMA WD 6: Devices-Dimensional Requirements.
- K. NEMA LD 3: High Pressure Decorative Laminates.
- L. NFPA 30: Flammable and Combustible Liquids Code.
- M. NFPA-45: Standard for Fire Protection for Laboratories Using Chemicals.
- N. OSHA 29-CFR-1910.1450: Occupational Exposure to Hazardous Chemicals in Laboratories.
- O. SEFA 1: Laboratory Fume Hoods - Recommended Practices.
- P. SEFA 7: Laboratory and Hospital Fixtures--Recommended Practices.
- Q. SEFA 8W: Laboratory Furniture--Casework, Shelving and Tables--Recommended Practices.
- R. UL 498: Attachment Plugs and Receptacles.
- S. UL 1805: Laboratory Hoods and cabinets, where applicable.
- T. FSC: Forest Stewardship Council.
- U. CARB: California Air Resources Board.
- V. "American Made": Casework wholly manufactured and assembled in USA.

1.4 DEFINITIONS

- A. Concealed Surfaces of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.
- B. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, and visible surfaces in open cabinets or behind glass doors.
 - 1. Ends of cabinets are defined as "exposed" except ends are defined as "concealed" where installed directly against and completely concealed by walls or other cabinets.
- C. Semiexposed Surfaces of Casework: Surfaces behind opaque doors, such as cabinet interiors, shelves, and dividers; interiors and sides of drawers; and interior faces of doors. Tops of cases 78 inches or more above floor and bottoms of cabinets more than 24 inches but less than 48 inches above floor are defined as "semiexposed."

1.5 COORDINATION

- A. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.

- B. Coordinate installation of laboratory casework with installation of laboratory equipment.

1.6 ACTION SUBMITTALS

- A. Manufacturer's data sheets on each product to be used, including:
 - 1. Test reports certifying that the casework finish complies with SEFA-8 standards for chemical and physical resistance performance requirements.
 - 2. Performance test reports from an independent testing lab on each specified top material.
 - 3. Preparation instructions and recommendations.
 - 4. Storage and handling requirements and recommendations.
 - 5. Installation methods.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Indicate locations of blocking and reinforcements required for installing laboratory casework.
 - 2. Indicate locations and types of service fittings, together with associated service supply connection required.
 - 3. Include details of utility spaces.
 - 4. Include indicators of exposed conduits, if required, for service fittings.
 - 5. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.
 - 6. Include coordinated dimensions for laboratory equipment specified in other Sections.
- C. Certificate of Origin: Manufacturer must supply with first submittal, an example of their Certificate of Origin declaring casework is wholly manufactured and assembled specifically in the United States, including city, county, and state locations. A notarized Certificate of Origin must be provided with closeout documents.
- D. Selection Samples: For each finish product specified, one complete set of color chips representing manufacturer's full range of available colors and patterns.
 - 1. One set of samples indicating full range of finishes for countertop specified.
 - 2. One set of casework samples indicating full range of finishes for casework specified.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish complete touchup kit for each type and color of casework finish provided. Include fillers, stains, finishes, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Cabinet Mounting Clips and Related Hardware: Quantity equal to 5 percent of amount installed, but no fewer than 20 of each type.
 - 2. Modular Countertop Units: Two extra units of each length and material installed.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that produces casework of types indicated for this Project that has been tested for compliance with SEFA 8 W.

- B. Installer Qualifications: Firm with 5 years experience in installation or application of systems similar in complexity to those required for this Project, plus the following.
 - 1. Authorized distributor of manufacturer.
- C. Mock-Up: Provide a mock-up for evaluation of fabrication techniques and application workmanship.
 - 1. Installation in area designated by Architect.
 - 2. Do not proceed with remaining work until installation is approved by Architect.
 - 3. As selected and required by Architect's request for mock-up: Install base cabinet with drawer and cupboard, one adjustable shelf, hinged door and applicable hardware. Wall case with adjustable shelf, hinged door and applicable hardware. Tall case with adjustable shelves, fixed center shelf, hinged door and applicable hardware, including a 3-point latching system.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished surfaces during handling and installation with protective covering of polyethylene film or other suitable material.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, utility roughing-in and wet-work are complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Established Dimensions: Where laboratory casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.
- C. Field Measurements: Where laboratory casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes to allow for trimming and fitting.
- D. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before enclosing them, and indicate measurements on Shop Drawings.
- E. For delivery and installation of laboratory casework and equipment, building conditions shall comply with AWI Standard 10.5 and 10.6 and be as follows:
 - 1. Flooring required to be placed under casework and equipment installed.
 - 2. Wood or metal blocking (wall grounds) installed within partitions to allow for immediate installation upon delivery.
 - 3. Heating and air conditioning systems providing consistent temperature and humidity conditions to comply with by AWI Standard Section 2.
 - 4. Relative humidity not less than 40 percent, nor more than 60 percent.
 - 5. Temperatures not less than 65 degrees F (18 degrees C) and not greater than 80 degrees F (27 degrees C) in areas of casework and equipment installation.
 - 6. Overhead mechanical, electrical and plumbing rough-in work is complete.
 - 7. Wet operations complete prior to delivery.

8. Ceiling grids (with or without ceiling tiles), overhead soffits, ductwork and lighting installed.
9. Painting complete.

1.11 WARRANTY

- A. Casework Manufacturer Warranty: 3 years from date of delivery. Warranty is for the conditions indicated below, and when notified in writing from Owner, manufacturer shall promptly investigate and address said deficiencies.
 1. Defects in materials and workmanship.
 2. Deterioration of material and surface performance below minimum SEFA 8W standards as certified by independent third party testing laboratory.
 3. Within the warranty period, we shall, at our option, repair, replace, or refund the purchase price of defective casework.
- B. Casework manufacturer shall be notified immediately of defective products, and be given a reasonable opportunity to inspect the goods prior to return. Casework manufacturer will not assume responsibility, or compensation, for unauthorized repairs or labor. Casework manufacturer makes no other warranty, expressed or implied, to the merchantability, fitness for a particular purpose, design, sale, installation, or use, of casework; and, shall not be liable for incidental or consequential damages, losses of or expenses, resulting from the use of their products.
 1. The warranty with respect to products from another company sold by the casework manufacturer is limited to the warranty extended by that other company.
- C. Casework manufacturer shall provide, with close-out documents, a Certificate of Warranty for products provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:
 1. Kewaunee Scientific Corporation; Style-1 wood casework.
 2. Approved equal.
- B. Source Limitations: Obtain laboratory casework from single source from single manufacturer unless otherwise indicated.
 1. Obtain countertops, sinks, accessories and service fittings from casework manufacturer.
- C. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Other manufacturers' laboratory casework of similar sizes and similar door and drawer configurations and complying with the Specifications may be considered. See Section 016000 "Product Requirements."

2.2 PERFORMANCE REQUIREMENTS

- A. System Structural Performance: Laboratory casework and support framing system shall withstand the effects of the following gravity loads and stresses without permanent deformation, excessive deflection, or binding of drawers and doors:
 - 1. Support Framing System: 600 lb/ft.
 - 2. Suspended Base Cabinets (Internal Load): 160 lb/ft.
 - 3. Work Surfaces (Including Tops of Suspended Base Cabinets): 160 lb/ft.
 - 4. Wall Cabinets (Upper Cabinets): 160 lb/ft.
 - 5. Shelves: 40 lb/sq. ft.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design laboratory casework installation.
- C. Seismic Performance: Laboratory casework installation shall withstand the effects of earthquake motions determined according to California Building Code.
 - 1. Design earthquake spectral response acceleration, short period (Sds) for Project is indicated on Drawings.
 - 2. Component Importance Factor: 1.5.
 - 3. Base Cabinet Load (Including Countertop and Load on Countertop): 320 lb/ft.
 - 4. Wall Cabinet (Upper Cabinet) Load: 160 lb/ft.

2.3 MANUFACTURERS

- A. Basis of Design: ICI (Institutional Casework Inc.) manufacturer of CampbellRhea, located at: 1865 Highway 641 North; Paris, TN 38242; Tel: 731-642-4251.
- B. Or Approved Equal.

2.4 CASEWORK CONSTRUCTION

- A. Wood veneer on plywood core: ICI/CampbellRhea Casework: Rotary cut, whole-piece, Maple.
- B. Cabinet Finish, Interiors and Exteriors Match Finished: Standard factory finish, refer to finish schedule.
- C. Drawer and Door Styles: Empire Drawer and Door Styling: Both door and drawer fronts are 3/4 inch (19 mm) thick; have a slight radius to the squared edges. Full flush overlay, vertical match grain, rotary cut, whole-piece, maple veneer doors and drawer fronts have a particleboard core and a 1/8 inch (3mm) maple lumber edge-band.
- D. Door and Drawer Hardware Style:
 - 1. Drawer and door pulls: AL-2: Extruded aluminum rod design.
 - 2. Sliding wood door pulls: RS -1: Recessed, metal finger grip is nickel-plated pull.
 - 3. Sliding glass door pulls: RS-2: Recessed, metal two-piece, screw together style with a bright chrome finish.
 - 4. Hinges: CP-1: Heavy-duty, institutional type, 5-knuckle hospital tipped, made from 0.083 inch (2 mm) thick chrome plated steel. Hinge is semi-concealed, 2 3/4 inches (70mm) high and has off-set wings; each wing has 5 screw holes for the door leaf and 4 screw

- holes for the case leaf, two of which are slotted for adjustability. Hinges are attached with Euro screws.
5. Latching Handle: Latching handle CP LH-1 is chrome plated, 4 1/4 inches (108 mm) long and streamline in design. Handle operates with 1/4 turn. Double door cases have latching handles on the right door and dummy handles on the left door. A three point latching system provides a positive engagement at the top and bottom of the door with tapered aluminum rods, which pull the door snug when they engage plastic strike plates. The rods are 5/16 inch (8 mm) in diameter and move in nylon guides attached to the back of the door. The middle of the door is secured by a latch plate, which engages the side of the case, or latches behind the left door on cases with double doors.
 6. Locking Handle: CP: Chrome plated locking handle is a latching handle with a lock mechanism incorporated into the handle head. On double door cases, the left door has a dummy handle, and the right door has the locking handle. Lock is laboratory grade with a 5-disc tumbler mechanism with a brushed chrome face. Tumblers and keys are brass, while the plug and cylinder is die cast zinc alloy. There are 500 key changes standard. Locks are keyed differently, master keyed and furnished with 2 keys per lock. Locks and corresponding keys are alpha-numerically coded for a quick match.
 7. Locks: Removable core standards: CP: Lock CP SL-1 is laboratory grade, cylinder cam lock, with a 5-disc tumbler mechanism with a chrome plated face. Tumblers and keys are brass, while plug and cylinder is die cast zinc alloy. A 180-degree turn of the key moves the lock cam into, or out of, a slot cut to receive it. There are 500 key changes standard. Locks are keyed differently, master keyed and furnished with 2 keys per lock. Locks and corresponding keys are alpha-numerically coded for a quick match. Lock CP SL-1 is equipped with a removable core, keying control. With the use of a control key, the key core of the lock assembly can be removed and a new key core inserted, changing the entire locking system in a matter of minutes. Key cores can be held out of the lock assembly until the project is completed, removing the security risk of lost or stolen keys during installation and construction. Casework manufacturer can provide control keys and replacement cores as required. Locks are furnished only when specified.
 8. Drawer Slides: Drawer slides DS-1: Epoxy powder coated, cold rolled steel, bottom/side mount, heavy-duty with a 100 lbs (45 kilograms) load capacity. They are equipped with heavy-duty, nylon rollers for smooth effortless operation. Slides are self-closing; and have automatic positive stop to prevent drawer's accidental removal, but allow for quick removal without tools.
 9. File Drawer Slides: File drawer slides FD-1: Zinc plated, cold rolled steel, heavy-duty, side mounted, and have a 125 lbs (56.25 kg) load capacity. They are equipped with heavy-duty, precision ball bearings, for smooth effortless operation. Slides are full extension with a positive stop, and a trigger finger release.

2.5 FABRICATION

- A. Units and configurations designated for accessibility by users shall comply with ATBCB ADAAG (ADA standards).
- B. Design, material and construction of casework, shelving and tables shall comply with SEFA 8W performance and resistance standards.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for its intended use.

- D. Base cabinets have a 2 1/4 inches (57 mm) by 1 inch (25 mm), solid hardwood horizontal front top frame member and 2 1/8 inches (54 mm) by 1 inch (25 mm), solid hardwood horizontal rear and side top frame members. Front intermediate rails are 3/4 inch (19 mm) by 2 1/2 inches (64 mm) solid wood. Back intermediate rails are furnished only when drawer separators are specified. Exposed exterior backs are 3/4 inch (19 mm) plywood. Cabinets with exposed interiors but unexposed exteriors have 1/4 inch (6 mm) plywood backs. Backs are 1/4 inch (6 mm) finished plywood in cabinets with exposed interiors; and, in cabinets with unexposed interiors, backs are 1/4 inch (6 mm) thick hardboard with melamine face, color coordinated to the interior stain. End panels with unexposed interior and unexposed exterior are 3/4 inch (19 mm) hardwood plywood. Bottom, shelves, and dividers in cabinets with exposed interiors are 3/4 inch (19 mm) plywood; with unexposed interiors is 3/4 inch (19 mm) hardwood plywood. If cabinet exceeds 36 inches (914 mm) in width, shelves shall be 1 inch (25mm) thick. Exposed edges of front top horizontal frame and intermediate rail members; end panels, bottom, shelves, and dividers are edged with 1/8 inch (3 mm) solid wood. Drawer separators, furnished only when specified, are 1/4 inch (6 mm) thick hardboard with wood grained melamine face.
- E. Cabinet construction is bored, doweled, dadoed, glued and screwed construction. Cabinets are enclosed without the use of common partitions. A full horizontal, mortise, tenon and glued, top frame is bored, doweled, glued, and reinforced with six (6) screws into the cabinet. Intermediate front rails and bottom rear horizontal parting rails are provided as required. Separators, where specified, are let into routed intermediate rails. Backs are recessed and encapsulated into dadoed end panels then screwed into the top and bottom case members. A standard enclosed toe space, 2-1/4 inches (57 mm) by 4 inches (102 mm) high, is provided, with toe rail bored, doweled and glued to end panels. Shelves are supported on heavy-duty, laboratory grade, twin pin plastic shelf clips, which fit into two double rows of holes drilled 1-1/4 inches (32 mm) on centers, in the case end panels for maximum shelf adjustability.
- F. Construction - Wall and Upper Cases: Wall and upper cases have a 1 inch (25 mm) plywood top and bottom panel. Adjustable shelves are 1 inch (25 mm) finished plywood in cases with exposed interiors and 1 inch (25 mm) hardwood plywood in cases with unexposed interiors. Backs are 1/4 inch (6 mm) finished plywood in cases with exposed interiors; and, in cases with unexposed interiors, backs are 1/4 inch (6 mm) thick hardboard with melamine face, color coordinated to the interior stain. End panels in cabinets with exposed interiors are 3/4 inch (19 mm) finished plywood; end panels in cabinets with unexposed interiors are 3/4 inch (19 mm) hardwood plywood. Exterior hanger rails are 4 inches (102 mm) by 3/4 inch (19 mm) hardwood plywood.
- G. Construction - Tall Cases: Top panels in tall cases with exposed interiors are 1 inch (25 mm) hardwood plywood; tall cases with unexposed interiors have top panels of 1 inch (25 mm) plywood. Bottom panels in tall cases with exposed interiors are 3/4 inch (19 mm) hardwood plywood; and unexposed interiors have 3/4 inch (19 mm) plywood. Interiors, whether exposed or unexposed, are stain color matched to the exterior finish. Adjustable shelves are 1 inch (25 mm) thick hardwood plywood if exposed; 1 inch (25 mm) plywood if unexposed. Shelves are edged with 1/8 inch (3 mm) solid hardwood edging. Backs in tall cases with exposed interiors and exposed exteriors, are 1/4 inch (6 mm) hardwood plywood. Backs are 1/4 inch (6 mm) finished plywood in cases with exposed interiors; and, in cases with unexposed interiors, backs are 1/4 inch (6 mm) thick hardboard with melamine face, color coordinated to the interior stain. End panels in tall cases with exposed end panels have 3/4 inch (19 mm) hardwood plywood. End panels in cases with unexposed end panels have 3/4 inch (19 mm) plywood. All exposed edges of hardwood plywood components and plywood components are edged with 1/8 inch (3mm) solid hardwood edging. Tall cases have two exterior hardwood plywood cross rails, 4 inches by 3/4 inch (102 mm x 19 mm). Tall cases are rigidly constructed, integral units with the strongest, most advanced joinery methods utilized of bored, doweled, dadoed, glued and

screwed construction. Each case is completely enclosed without the use of common partitions and has flush construction with overlapping doors to provide a dust resistant interior. The top panel is bored, doweled and glued into end panels; and the bottom panel is bored, doweled and glued into end panels and glued and screwed to the back. Additional back cross rails are provided as required. Backs are recessed and encapsulated into dadoed end panels and screwed to the top and bottom tall case members. An enclosed toe space 2-1/4 inch by 4 inches (57 mm by 102 mm) is provided with toe rail securely bored, doweled and glued to end panels and bottom panel. Adjustable shelves are supported on heavy-duty laboratory grade, twin pin plastic shelf clips, which fit into two rows of holes drilled 1-1/4 inches (32 mm) on centers in the end panels, for maximum shelf adjustability.

- H. Drawer front is 3/4 inch (19 mm) thick. Drawer faces are screwed to the face of a full drawer box. Drawer box front, sides and back are 1/2 inch (12 mm), 9-ply laminated hardwood plywood, FSC 100% and CARB Phase 2 compliant. Drawer bottom is 1/4 inch (6 mm) thick hardboard with white melamine face. All four corners of the drawer are dovetailed and glued. The top edges of drawer box are radiused. Drawer bottom is let in on four sides, and securely glued underneath with a continuous bead of glue around the perimeter of the drawer bottom. In cabinets 24 inches (610 mm) or less in width, drawers have one pull. In cabinets over 24 inches (610 mm) wide, drawers have two pulls.
- I. Construction - Hinged Doors:
1. Hinged solid doors 48 inches (1219 mm) or less in height, 3/4 inch (19 mm) thick and overlap the opening on all sides. Doors have one pull. Door has two heavy-duty, institutional type, and 5-knuckle hinges. Doors are secured by a friction roller catch and a metal strike plate.
 2. Hinged solid doors, over 48 inches (1219 mm) in height, are 3/4 inch (19 mm) thick and overlap the opening on all sides. Single doors and right door of double doors have a latching handle. A three point latching system provides single doors and right door of double doors positive engagements at the top and bottom of the door with tapered aluminum rods, which engage plastic, strike plates and pull the door snug. The rods are 5/16-inch (8 mm) in diameter and move in nylon guides attached to the back of the door. The middle of the door is secured by a latch plate, which engages the side of the case, or latches behind the left door on cases with double doors and securely hold the door shut. Right door of double doors lap over applied astragal on the left door. Doors have four hinges. On double doors left door is additionally secured with two friction roller catches with metal strike plates.
 3. Hinged glazed doors 48 inches (1219 mm) or less in height are 3/4 inches (19 mm) by 3 inches (76 mm) with glass panel. Doors overlap opening 1/4 inch (6 mm) on all sides. The frame joints are bored, doweled and glued. The balance of the door is glass. Right door of double doors lap over an applied astragal on the left door. Doors have one pull, two hinges and are secured by friction roller catches with metal strike plate. Glass panels are held in place by a press-fit, flexible and removable, rubber strip.
 - a. Glass is tempered safety glass is specially heat-treated glass, 1/4 inch (6 mm) thick with a minimum of 88 percent clarity.
 - b. Glass is DSB glass is double strength, grade "B", and 1/8 inch (3 mm) thick.
 4. Hinged glazed doors, over 48 inches (1219 mm) in height, same construction with a 3/4 inch (19 mm) by 3 inch (76 mm) center cross frame member with glass panel. Single doors and right door of double doors have a latching handle. Left door of double doors has a fixed handle, which is the same size and finish as a latching handle. A three point latching system provides single doors and right door of double doors positive engagement at the top and bottom of the door with tapered aluminum rods, which engage plastic, strike plates and pulls the door snug. The rods are 5/16-inch (8 mm) in diameter and move in nylon guides attached to the back of the door. The middle of the

door is secured by a latch plate, which engages the side of the case, or latches behind the left door on cases with double doors and securely hold the door shut. Right door of double doors laps over an applied astragal on the left door. Doors have four hinges. The left door of double doors is additionally secured by two friction roller catches and metal strike plates. Glass panels are held in place by a press-fit, flexible and removable, rubber strip.

- a. Glass is tempered safety glass is specially heat-treated glass, 1/4 inch (6 mm) thick with a minimum of 88 percent clarity.
- b. Glass is DSB glass is double strength, grade "B", and 1/8 inch (3 mm) thick.

J. Construction - Sliding Doors:

1. Sliding solid doors are 3/4 inch (19 mm) thick with squared edges; plastic laminate style sliding doors are 3/4 inch (19 mm) laminated particleboard core and operate in an overhead aluminum sliding door track assembly with adjustable nylon roller hangers. Doors are secured at the bottom of the cabinet with two plastic guides per door that operate in recessed, channels. Each door has one recessed pull with finger grip. Pull is located on outside edge of the door face. Lock is furnished when specified.
2. Sliding glazed doors, 48 inches (1219 mm) or less in height, have a 3/4 inch (19mm) by 3 inches (76 mm), plywood frame with 1/8 inch (3 mm) thick DSB glass. The balance of the door is glass. Doors operate in an overhead aluminum sliding door track assembly with adjustable nylon roller hangers. Doors are secured at the bottom of the cabinet with two plastic guides per door, which operate in recessed channels. Each door has one pull recessed nickel-plated metal pull with finger grip. Pull is located on outside edge of the door face. Lock is furnished when specified. Glass panels are held in place by a press-fit, flexible and removable, rubber strip.
 - a. Glass is tempered safety glass is specially heat-treated glass, 1/4 inch (6 mm) thick with a minimum of 88 percent clarity.
 - b. Glass is DSB glass is double strength, grade "B", and 1/8 inch (3 mm) thick.
3. Sliding glazed doors, over 48 inches (1219 mm), have a 3/4 inch (19 mm) by 3 inches (76 mm), plywood frame with a center cross frame member and 1/4 inch (6 mm) tempered glass. The balance of the door is glass. Doors operate in an overhead aluminum sliding door track assembly with adjustable nylon roller hangers. Doors are secured at the bottom of the cabinet with two plastic guides per door, which operate in recessed channels. Each door has one recessed nickel-plated metal pull with finger grip. Pull is located on outside edge of the door face. Lock is furnished when specified. Glass panels are held in place by a press-fit, flexible and removable, rubber strip. Glass is tempered safety glass is specially heat-treated glass, 1/4 inch (6 mm) thick with a minimum of 88 percent clarity.
4. Sliding glass doors are 1/4 inch (6 mm) thick float glass. Doors have polished vertical edges and swiped horizontal edges. Doors operate in sliding aluminum door track assembly, which has an aluminum track at the bottom, and an aluminum channel mounted at the top of the cabinet. The glass rests in aluminum shoes with nylon rollers. The top swiped edge of the glass is fitted with plastic glide clips to assure smooth movement in the channel. Each door has one two-piece recessed round pull. Pull is located on outside edge of the door face. Lock is furnished when specified.

K. Construction - Tables: Open Frame Table exterior rails are 4-13/16 inches (122 mm) by 13/16 inch (21 mm), solid hardwood lumber. Interior rails are a minimum of 3/4 inch (19 mm) hardwood plywood. Compartment bottoms are 1/4 inch (6 mm) plywood. Legs are 2 1/4 inches (57 mm) square solid hardwood; legs are not laid up. Leg stretchers, when specified, are 2-1/8 inches (54 mm) by 1 inch (25 mm) thick, solid hardwood. Openings are routed in the one-piece rail when drawers or compartments are required. A minimum of two interior cross rails are doweled and glued into exterior rails. Compartment bottoms are let into dadoed grooves in

cross rails and the front and back rails, then glued on all four edges. Exterior rails are grooved to receive 3/8 inch (9 mm) flanges on the 13 gauge steel corner stabilizing bracket. Legs are secured to the stabilizing bracket with a 5/16 inch (8 mm) threaded hanger bolt, machine screwed into the solid leg a depth of at least two inches. The stabilizing bracket is attached to the leg bolt by a 5/16"locking nut with serrated flange. Tightening the locking nut on the bolt, draws the stabilizing bracket flanges against the solid hardwood rail, and clamps them against the solid hardwood leg. The stabilizing bracket is further secured to the solid hardwood rails by four (4) Euro screws. Legs have molded black polyethylene, closed bottom, leg shoes. Exterior rails are also grooved to accept Z- clips for attaching the top.

2.6 MATERIALS

- A. Maple Lumber: Grade FAS or better, air-dried and kiln dried to 6 percent moisture content, then tempered to 7 to 8 percent prior to fabrication. Lumber exposed to view, is free of stains, splits, shakes, season checks and other similar defects. Other hardwoods are grade FAS or better, air dried to 6 percent moisture content, then tempered to 7 to 8 percent prior to fabrication. Other hardwoods are used in semi-exposed, or unexposed, areas and comply with NHLA grading for FAS or better lumber.
- B. Maple Plywood: Plywood is rotary cut, whole piece Maple, select grade A-1, cross-banded, and has a veneer core. The 1 inch (25 mm) plywood is a minimum of 9-ply, 3/4 inch (19 mm) plywood is a minimum of 7-ply, 1/2 inch (12 mm) is a minimum of 5 ply, 1/4 inch (6 mm) is minimum of 3 ply, and 3/32 inch (2.4 mm) is 3-ply. Other hardwood plywood is sound grade, has a solid core and is suitable for semi-exposed or unexposed areas. All plywood shall be CARB Phase 2 compliant.
- C. Hardboard used in drawer bottoms and unexposed backs, consists of super-refined wood fibers and chips, highly compressed into a hard, dense, 1/4 inch (6 mm) thick, homogeneous sheet, faced with a color coordinated (to cabinet finish) melamine on the exposed face. Natural finish selections have a natural, white melamine face. All other finish colors have a flat, color coordinated melamine face. Physical properties: Average MOR is 5,000 lbs/sq inches (3.5 kgf/sq mm); density is 48 lbs/cu ft (0.6 kg/cu m); and MOE of 500,000 psi (350 kgf/sq mm). All hardboard shall be CARB Phase 2 compliant.

2.7 FINISHES

- A. Wood Cabinets: Exterior and interior surfaces of cabinets receive the full finishing process consisting of baked on: specified NGR stain, two coats of protective moisture resistant sealer and two applications of a topcoat of clear catalyzed chemical resistant lacquer.
 - 1. Interior Surfaces: The unexposed interior surfaces of cupboards, wall cases, upper cases, and tall cases must match exterior color and receive stain (color coat), a protective coat of moisture resistant sealer, and two applications of a clear, catalyzed, chemical resistant lacquer topcoat.
 - 2. Other Surfaces: Unexposed surfaces such as unexposed end panels, unexposed backs, drawer sides and drawer bottoms are processed through standard finishing steps and receive a baked on protective coat of moisture resistant sealer, but no stain (color coat).
 - 3. Finish shall comply with SEFA-8W resistance standard acceptable levels for casework surfaces. An independent 3rd party testing facility's written certification must be provided to establish that final finish has no more than four, SEFA-8W "Level 3" conditions.
 - 4. Any deviations from the specified finishing procedures will be considered defective Work and rejected by the Architect.

2.8 CABINET HARDWARE

- A. Provide laboratory casework manufacturer's standard finish, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.
- B. Lock GL-1 is ratchet type glass door lock, with a disc tumbler mechanism and a polished nickel plate finish. The ratchet bar adjusts from 1 inch (25 mm) to 3 3/8 inches (86 mm). Two keys are provided; master keying is not available. Locks are furnished only when specified.
- C. Friction roller catch is zinc plated steel catch with a spring cushioned; polyethylene roller, and a metal strike plate. Screw mounted catches and strike plate have slotted holes for adjustability.
- D. Sliding door track assembly DT-1 has an overhead aluminum track and adjustable, nylon roller hangers. The lipped edge of the upper aluminum track prevents rollers from jumping track. Two hard plastic guides are mounted on the bottom interior of the door and operate in recessed channels.
- E. Sliding glass door track assembly GT-1 has an aluminum bottom track, and an aluminum channel mounted at the top of the cabinet. The glass rests in aluminum shoes with nylon rollers, which operate in the bottom track. The top swiped edge of the glass is fitted with plastic glide clips to assure smooth movement in the channel.
- F. Shelf clips are made from clear polycarbonate and are laboratory standard grade. Clips have double, 3/16 inch (5 mm) diameter pins and are equipped with shelf lock hold down tabs for 3/4 inch (18 mm) or 1 inch (25 mm) thick shelves.
- G. Sliding door lock, when specified, 5-disc tumbler mechanism with a dull chrome plated face. Tumblers and keys are brass, while plug and cylinder are die cast steel. Pushing in on the lock while turning the key, engages a lock bolt into the strike plate; a turn of the key, unlocks the bolt. There are 200 key changes standard. Locks are keyed differently, master keyed and furnished with 2 keys per lock. Locks and corresponding keys are alpha-numerically coded for a quick match.
- H. Leg shoes are closed-bottom style, 2 1/4 inches (57 mm) square, and molded of 1/8 inch (3 mm) black polyethylene.

2.9 COUNTERTOPS

- A. Epoxy Resin (Rhearesin) is 1 inch (25 mm) thick, molded from a modified epoxy resin. Exposed edges and corners are radiused, and a drip groove is provided under surface in areas where sinks are installed. Curb is 4 inches (102 mm) high. Color: Black.

2.10 ACCESSORIES

- A. Burette Rods: 1/2 inch (12 mm) diameter, anodized aluminum, and either 18 inches (457 mm) or 24 inches (610 mm) long. Rods are furnished with a tapered aluminum adapter to fit rod socket.
- B. Clamps: 1 inch (25 mm) square aluminum stock, with two, 3/4 inch (19 mm) diameter openings, at right angles to each other, bored through sides. Openings are for upright rods and

crossbars, or Greenlaw Arms. Thumb screw into each end of the clamp; tighten against the rods to hold positions.

- C. Crossbars and Greenlaw Arms: 3/4 inch (19 mm) diameter, anodized aluminum rods, with ends rounded.
- D. Rod Sockets: Mushroom type, machined from a solid aluminum rod. Sockets are held in place by a heavy aluminum lock nut and washer.
- E. Upright Rods: 3/4 inch (19 mm) diameter, anodized aluminum, 36 inches long with a rounded top and a tapered bottom to fit rod sockets.
- F. Reagent Shelves: Provide as indicated, fabricated from same material as adjacent countertop, unless otherwise indicated.
- G. Adjustable Wall Shelf Supports: Standard is anodized chrome standard and shelf brackets. Epoxy powder coating is an option and must be specified.
- H. Metal Key Cabinets.
- I. Plastic Tote Tray.
- J. Pegboards: Clear acrylic, epoxy, or phenolic-composite pegboards with removable polypropylene pegs and stainless-steel drip troughs with drain outlet.

2.11 SERVICE FIXTURES

- A. Electrical Components, Devices, and Accessories shall be labeled to comply with NFPA 70, Article 100 and marked for its intended use.
- B. Provide service fixtures and fittings that comply with SEFA 7.
 - 1. Provide service fixtures and fittings that comply with recommendations of SEFA 7.
- C. Electrical Fixtures are 3-wire grounded, 20 A, 125V AC, with stainless steel cover plates and cadmium-plated steel boxes. Pedestal boxes are black, cast aluminum with conduit nipples and lock nuts. When specified, G.F.C.I., ground fault circuit interrupter fixtures are available. G.F.C.I. fixtures are 20 A, 125V AC, with black nylon faceplate.
 - 1. Receptacles: Comply with NEMA WD 1, NEMA WD 6, FS W-C-596, and UL 498. Duplex type, Configuration 5 20R.
- D. Epoxy resin sinks are drop-in style, non-glaring black, and specially modified epoxy resins, molded in one solid piece or optimum physical and chemical resistance. Inside corners are coved and the bottom is dished to the outlet. Outlets are polypropylene with 1 1/2 inch (38 mm) NPS threads.
- E. Gas, Air and Vacuum Cocks: Ground key cocks, made from high grade, brass forgings, have integral ten-serration, non-slip hose end. Wing or knob handle has color-coded index, is one-piece construction, precision ground, and lapped to fit cock chamber. Handle operates with a 1/4 turn, and is spring-loaded for constant pressure and automatic take up. Provide needlepoint valves for high pressures and oxygen service where scheduled.

- F. Multiple Service Fixtures: Triple chrome plated or electro-statically applied polyester powder coated fixtures have one cold water faucet and two ground key cocks for gas, air, or vacuum services. Faucet has a rigid gooseneck, one four-arm or knob handle, and serrated hose nozzle. Vacuum breaker furnished when specified. Faucet with integral vacuum beaker is furnished, when specified. Ground key cocks have serrated non-slip hose end and color-coded, spring-loaded wing handles.
- G. Service Fixtures: Triple chrome plating or electro-statically applied polyester powder coating, heavy-duty construction for water, gas, steam, or other services and specifically designed for laboratory use. Hot and/or cold Water Faucets are cast from red brass with color-coded index handles. Faucets have serrated hose nozzles, unless specified otherwise. Goosenecks are rigid. Fixture outlets are tapped 3/8-inch (10 mm) I.P.S. for aerators, vacuum breakers, hose connections, or other accessories. Faucets with an integral vacuum breaker.
- H. Stainless steel sinks have a satin finish. Sink is 18 gauge, type 304, 18-8 stainless steel, with heavily undercoated bottoms and positive pitch drains. Outlets are chrome-plated brass. Drain holes are 3 1/2 inches (89 mm) diameter for 4 1/2 inches (114 mm) stainless steel cup strainers. The cup strainer has a neoprene stopper.
- I. Vacuum Breakers: Watts NLF-9, or comparable, vacuum breakers are brass with polished chrome plating, screw-in type with stainless steel working parts, and durable rubber diaphragm and disc. Vacuum breaker is for hot or cold faucet and has a primary valve with a soft disc that seat against mating part. The secondary check valve utilizes a soft disc to metal seating. Breaker is tapped 3/8-inch (10 mm) N.P.T. Vacuum breaker is not intended for constant high pressures. Vacuum breakers shall be furnished where scheduled.

2.12 EQUIPMENT AND APPLIANCES

- A. Flammable Liquid Storage Cabinets: Provide units that comply with requirements of NFPA 30.
 - 1. Wood, UL rated cabinet.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not begin installation until substrates have been properly prepared.
 - 1. Walls and openings are plumb, straight and square.
 - 2. Concrete floors level within 1/8 inch (3 mm) level per 10 foot (3000 mm) run, non-accumulative, when tested with a straight edge in any one direction.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 COORDINATION

- A. Laboratory equipment contractor shall furnish equipment to the building, setting in place, leveling and scribing to walls and floors. Furnish plumbing and electrical fixtures, including nipples and lock nuts needed to secure each fixture to the equipment.
- B. Coordination with mechanical contractor who shall furnish, install and connect drain lines, service piping, vents, re-vents, in-line vacuum breakers, special plumbing fixtures, traps and tailpieces. Work to be completed through, under or along backs of working surfaces as required and complete final connection of services. Assemble, install and make final connections of service fixtures furnished by casework contractor, including service fixtures in fume hoods. Furnish, install and connect fume hood blowers, motors and all related ductwork. Furnish, install and connect service piping within fume hoods, including final connection.
- C. Coordination with electrical contractor who shall furnish, install and connect electrical service lines, wire and conduit within the equipment, including reagent racks and fume hoods. Work to be completed through, under or along backs of working surfaces as required and complete final connection of services. Install and make final connections of electrical fixtures provided by casework installer, including electrical fixtures in fume hoods.

3.3 INSTALLATION OF CASEWORK

- A. Comply with installation requirements in SEFA 2. Install level, plumb, and true in line; shim as required using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:
 - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
 - 2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
 - 3. Variation of Faces of Casework from a True Plane: 1/8 inch in 10 feet.
 - 4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
 - 5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
- B. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.
- C. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions, with fasteners spaced not more than 16 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
 - 1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches o.c. and at sides of cabinets with not less than two fasteners per side.
- D. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 16 inches o.c.
- E. Install hardware uniformly and precisely.
- F. Adjust operating hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.4 INSTALLATION OF COUNTERTOPS

- A. Comply with installation requirements in SEFA 2. Abut top and edge surfaces true in plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints where indicated on Shop Drawings.
- B. Field Jointing: Where possible, make in same manner as shop-made joints, using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Shop prepare edges for field-made joints.
- C. Fastening:
 - 1. Secure countertops, except for epoxy countertops, to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each cabinet front, end, and back.
 - 2. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches o.c.
 - 3. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch and plug hole flush with material equal to countertop in chemical resistance, hardness, and appearance.
- D. Provide holes and cutouts required for service fittings.
- E. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.
- F. Dress joints smooth, remove surface scratches, and clean entire surface.

3.5 INSTALLATION OF SINKS

- A. Comply with installation requirements in SEFA 2.
- B. Semiflush Installation of Stainless Steel Sinks: Before setting, apply sink and countertop manufacturers' recommended sealant under rim lip and along top. Remove excess sealant while still wet and finish joint for neat appearance.

3.6 INSTALLATION OF LABORATORY ACCESSORIES

- A. Install accessories in accordance with Shop Drawings, installation requirements in SEFA 2, and manufacturer's written instructions.
- B. Securely fasten adjustable shelving supports, stainless steel shelves, and pegboards to partition framing, wood blocking, or reinforcements in partitions.
- C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.
- D. Securely fasten pegboards to partition framing, wood blocking, or reinforcements in partitions.

3.7 INSTALLATION OF SERVICE FITTINGS

- A. Comply with requirements in other Sections for installing water and laboratory gas service fittings and electrical devices.
- B. Install fittings in accordance with Shop Drawings, installation requirements in SEFA 2, and manufacturer's written instructions. Set bases and flanges of sink- and countertop-mounted fittings in sealant recommended by manufacturer of sink or countertop material. Securely anchor fittings to laboratory casework unless otherwise indicated.

3.8 CLEANING AND PROTECTING

- A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- B. Protect countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches o.c.
- C. Protect installed products until completion of project.
- D. Touch-up, repair or replace damaged products before Substantial Completion.
- E. A qualified manufacturer representative shall demonstrate operation and maintenance procedures of the installed casework and equipment to the Owners personnel.

END OF SECTION 12 35 53.19

SECTION 12 35 53.25 – ADAPTABLE LABORATORY BENCH SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Tables Frames and Work Surfaces
 - 2. Rear Support Frame Structures
 - 3. Shelving Assemblies
- B. Related Requirements:
 - 1. Section 11 53 13 "Laboratory Fume Hoods" for fume hoods.
 - 2. Section 12 35 53.19 "Wood Laboratory Casework".

1.3 SYSTEM DESIGN REQUIREMENTS

- A. Formed steel frame style support structures, tables and cantilevered storage units.
- B. Rear Support Frames: Vertical support structure for tables, shelves and service chase designed for service lines, data and electrical cables.
 - 1. Modular units shall be suitable for wall, peninsula or island configurations.
 - 2. Rear frame will be supported with structural tables, or anchored to wall.
 - 3. Bench system shall be pre-wired and pre-plumbed, with cut outs specified to accommodate data services. Cabling plug-ins and service line quick connects per specification requirements.
- C. Tables Frames: Modular work surface support structures allowing mechanically fastened height adjustability.
 - 1. Free standing and adjustable height work surface frames equipped with leveling device.
- D. Bench System Requirements:
 - 1. Bench system shall be constructed of a steel welded frame with slotted uprights which will support the upper shelving and work surface table frame.
 - 2. Electric/data, outlets, and service supply lines are contained in the tubular frame serving as a utility chase.
 - 3. The vertical height of table work surfaces can be adjusted to 30", 32", 34", and 36" AFF (actual height without levelers); shelves are adjustable on 1" increments, from 56"-84" AFF nominal.
 - 4. Services including electric/data, phone, and plumbing; all terminate at the top of the vertical support/chase.
 - 5. The bench system shall ship complete, pre-wired and pre-plumbed with minimal final assembly using simple hand tools.

1.4 ACTION SUBMITTALS

- A. Manufacturer Product Data.
- B. Shop Drawings.

1.5 QUALITY ASSURANCE

- A. Single source responsibility: Laboratory furniture system, casework, work surfaces, laboratory equipment, chemical fume hoods and accessories shall be furnished and installed by a single laboratory furniture and equipment contractor.
- B. Manufacturer's qualifications: Modern plant with proper tools, dies, fixtures and skilled workmen to produce high quality laboratory casework and equipment, and shall meet the following minimum requirements:
 - 1. Five years or more experience in manufacturing of laboratory casework and equipment.

1.6 REFERENCE STANDARDS

- A. SEFA (Scientific Equipment and Furniture Association) standards apply to all casework, work surfaces, and fixtures.
 - 1. SEFA 1.2 – Laboratory Fume Hoods
 - 2. SEFA 2.3 – Installation of Scientific Laboratory Furniture and Equipment.
 - 3. SEFA 3 – Work Surfaces
 - 4. SEFA 7 – Laboratory and Hospital Fixtures
 - 5. SEFA 8 – Laboratory Casework
 - 6. SEFA 10 – Adaptable Laboratory Furniture Systems

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Properly schedule and coordinate delivery of equipment so that installation of material is per the general contractor/owner's schedule.
- B. Protect finished surfaces from soiling or damage during handling and installation.

1.8 FIELD CONDITIONS

- A. Do not deliver or install equipment until the following conditions have been met:
 - 1. Windows and doors are installed and the building is secure and weather tight and humidity levels are suitable for delivery of casework.
 - 2. Overhead Ceiling Grid, overhead ductwork and lighting are installed.
 - 3. All painting is completed and floor tile is installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Jamestown Metal Products Division of Institutional Casework, Inc., 178 Blackstone Avenue, Jamestown, New York, 14701.
 2. Approved equal.
- B. Source Limitations: Obtain from single source from single manufacturer unless otherwise indicated.
- C. Design, materials, construction and finish of casework specified is the minimum acceptable standard of quality for adaptable laboratory furniture.

2.2 WORK SURFACE TABLES FRAMES

- A. Minimum requirements for Work Surface Table Frames:
1. Work surface support frame: 2" outside diameter wall and 1.73" inner telescoping leg 11 gauge tubing cold rolled and/or type 304, #4 stainless steel tubing. 0.122 wall ASTM A513 type 1, HRP&O Flash Scarfed tubing. Levelers are 3/8-16" UNC thread x 2 1/2" Long.
 2. Finish [Specifier's Option]:
 - a. Chemical resistant epoxy powder paint.
 - b. #4 on type 304 stainless steel.
- B. Work Surface Table Frames, Available Sizes [Specifier's Option]:
1. Nominal table frame dimensions:
 - a. Width: 42", 48", 60", 72", 84", 96"
 - b. Depth (for 3" Deep Upright Post): 24", 27", 30", 33", 36" measured from front and rear edges of countertop. ("B" dimension = 21", 24", 27", 30", 33" as measured from front of the 3" Upright to front of countertop.)
 - c. Depth (for 6" Deep Upright Post): 27", 30", 33", 36", 39" measured from front and rear edges of countertop. ("B" dimension = 21", 24", 27", 30", 33" as measured from front of 6" Deep Upright Post to front of countertop.)
 - d. Adjustable Height: 30", 32", 34", and 36" nominal AFF including 1 inch thick countertop.
 2. Front table legs are 2" outside diameter, 11 ga. (0.120" wall) tubing with telescoping 11 gauge inner leg, sized to move freely even with paint applied. The table legs are capable of vertical adjustment in two-inch increments, from 30" to 36" AFF
 3. Table frames consist mainly of 11 gauge and 14 gauge structural steel members.
 4. [Specifier's Option]: A Cabinet Stop (ordered separately) shall be located under the work surface frame to position the 22" deep (or 22 7/8", if specified, for Overlay construction) mobile base cabinet 1" behind the front edge of the work surface. Cabinet Stop shall be 7" high to accommodate Sitting & Standing Height mobile cabinets beneath Table Frame.
 5. Table Frame load rating: 100 lb. per linear foot of work surface width up to a maximum of 800 lb. With 800 lb. uniformly distributed load applied to an 8' work surface, the maximum allowable deflection shall be .125" measure at the center of the front rail.
- C. Four-Legged, Height - Adjustable Table

1. Nominal table frame dimensions:
 - a. Width: 42", 48", 60", 72", 84", 96"
 - b. Depth: 18", 21", 24", 27", 30", 33" and 36"
 - c. Adjustable Height: 30", 32", 34", and 36" nominal AFF, including 1 inch top.
2. All table leg members are 2" outside diameter, 11 gauge (0.120" wall) tubing with telescoping 11 gauge inner leg.
3. Work surface frames 11 and 14 gauge formed steel.

2.3 WORK SURFACES

- A. General requirements for work surfaces:
 1. All work surface table frame supports and support hardware shall be available in type 304 stainless steel (#4 finish) or powder coated cold rolled steel.
 2. Work surfaces shall be available in phenolic resin, epoxy resin, or 304 stainless steel with #4 finish
 3. Work surfaces shall be corner notched to the rear vertical frame and hang 3" or 6" behind the face of the vertical support, respectively.
 4. Load capacity: the work surface load rates are dependent of the work surface table frame and performance ratings (2.02).
- B. Work surfaces: (Specifier Option):
 1. Nominal dimensions:
 - a. Widths: 42", 48", 60", 72", 84", and 96"
 - b. Depth: 18", 24", 27", 30", 33", 36" and 39" (depths are specific to upright/table – refer to catalog chart)
- C. Work surface Types - Material Options (Specifier Option):
 1. Phenolic Resin (Trespa, or equivalent) – 1" thick
 2. Epoxy Resin (Durcon, or equivalent) – 1" thick.
 3. 304 Stainless Steel, #4 finish – 1" thick.

2.4 METAL FINISHES

- A. Preparation: Metal shall be treated with a heated alkaline based acid solution, rinsed with water, and a coat of epoxy-link applied; immediately dried in heated ovens, then gradually cool prior to application of finish.
- B. Application: Electrostatically apply epoxy powder coat of selected color and bake in controlled high temperature oven to assure a smooth, hard satin finish. Surfaces shall have a chemical resistant, high grade laboratory furniture quality finish of the following thicknesses:
 1. Exterior and interior surfaces exposed to view: 1.8 – 3 mils.
 2. Backs of cabinets and other surfaces not exposed to view: 1.8 mils minimum.
- C. Chemical Spot Test :
 1. Test procedure: Place test panel on a flat surface, clean with soap and water and blot dry. Condition the test panel for 48 hours at 73°F ± 3°F and 50% ± 5% relative humidity. Panel will be subjected to chemical reagents according to SEFA 8 M-2010 Recommended Practice using one of the following two test methods:
 - a. Method A – Test volatile chemicals by placing a cotton ball saturated with reagent in the mouth of a 1-oz. bottle and inverting the bottle on the surface of the panel.

- b. Method B – Test non-volatile chemicals by placing five drops of the reagent on the surface of the panel and covering with a 24 mm watch glass, convex side down.
 - c. For both test methods, leave the reagents on the panel for a period of one hour. Wash off the panel with water, clean with detergent and naphtha, and rinse with deionized water. Dry with a towel and evaluate after 24 hours at 73°F ± 3°F and 50% ± 5% relative humidity using the following rating system.
2. Evaluation ratings:
 - a. Level 0 – No detectable change.
 - b. Level 1 – Slight change in color or gloss.
 - c. Level 2 – Slight surface etching or severe staining.
 - d. Level 3 – Pitting, cratering, swelling, or erosion of coating. Obvious and significant deterioration.
3. Acceptance level: No more than four (4) level 3 conditions
4. Test results: Two (2) level 3 conditions exist. See data below.

<u>REAGENT</u>	<u>METHOD</u>	<u>RATING</u>
Acetate, Amyl	A	0
Acetate, Ethyl	A	0
Acetic Acid, 98%	B	1
Acetone	A	0
Acid Dichromate, 5%	B	0
Alcohol, Butyl	A	0
Alcohol, Ethyl	A	0
Alcohol, Methyl	A	0
Ammonium Hydroxide, 28%	B	0
Benzene	A	0
Carbon Tetrachloride	A	0
Chloroform	A	0
Chromic Acid, 60%	B	2
Cresol	A	1
Dichlor Acetic Acid	A	2
Dimethylformamide	A	1
Dioxane	A	1
Ethyl Ether	A	0
Formaldehyde, 37%	A	0
Formic Acid, 90%	B	3
Furfural	A	2
Gasoline	A	0
Hydrochloric Acid, 37%	B	0
Hydrofluoric Acid, 48%	B	1
Hydrogen Peroxide, 28%	B	0
Iodine, Tincture of	B	2
Methyl Ethyl Ketone	A	1
Methylene Chloride	A	1
Mono Chlorobenzene	A	0
Naphthalene	A	0
Nitric Acid, 20%	B	1
Nitric Acid, 30%	B	1
Nitric Acid, 70%	B	3
Phenol, 90%	A	0
Phosphoric Acid, 85%	B	0

Silver Nitrate, Saturated	B	1
Sodium Hydroxide, 10%	B	0
Sodium Hydroxide, 20%	B	0
Sodium Hydroxide, 40%	B	0
Sodium Hydroxide, Flake	B	0
Sodium Sulfide, Saturated	B	0
Sulfuric Acid, 25%	B	0
Sulfuric Acid, 77%	B	0
Sulfuric Acid, 96%	B	0
Sulfuric Acid (77%) & Nitric Acid (70%), (equal parts)	B	2
Toluene	A	0
Trichloroethylene	A	0
Xylene	A	0
Zinc Chloride, Saturated	B	0

D. Hot Water Test

1. Test procedure: Hot water (100°C±3%) shall be allowed to trickle (with a steady stream and at a rate of not less than 6 ounces [177.44cc] per minute) on a finished surface, which shall be set at an angle of 45-degrees, for a period of five minutes.
2. Acceptance level: After cooling and wiping dry, the finish shall show no visible effects from the hot water.
3. Test results: The finish shows no visible effect due to the hot water.

E. Finish Impact Test:

1. Test procedure: Position the 18 GA CRS test panel with nominal paint thickness of 3 mils on a smooth concrete floor. A one-pound ball (approximately 2" in diameter) shall be dropped from a distance of 12" onto a flat horizontal surface.
2. Acceptance level: There shall be no visual evidence to the naked eye of cracks or checks in the finish due to impact.
3. Test results: There is no visual evidence of any cracks or checks due to impact.

F. Paint Adhesion on Steel:

1. Test procedure: This test is based on ASTM D3359-02 "Standard Test Methods for Measuring Adhesion by Tape Test 1 – Test Method B". Two sets of six parallel lines 2mm apart shall be cut with a razor blade to intersect at right angles thus forming a grid of 25 squares. The cuts shall be made just deep enough to go through the coating, but not into the substrate. Brush the grid area lightly with a soft brush, and then place a piece of tape over the grid. Rub the tape firmly with the eraser of a pencil to ensure good contact. Remove the tape by rapidly pulling it back upon itself as close to an angle of 180° as possible.
2. Acceptance level: A 4B rating or better (ninety-five percent or more of the grid area shall show finish intact).
3. Test results: 100% of the squares remained intact after the test.

G. Paint Hardness on Steel:

1. Test procedure: This test is based on ASTM D3363-01 "Standard Test Method for Film Hardness by Pencil Test". Clip a corner of the sample at 45° exposing a raw metal edge. Place the sample on a raw metal base plate so that the exposed metal edge of the sample makes contact with the turned up side of the base plate. Remove approximately

6mm of wood from a 4H pencil, being careful to leave an undisturbed smooth cylinder of lead. Holding the pencil at an angle of 90° to an abrasive paper, rub the lead against the paper maintaining an exact angle of 90° section until a flat smooth and circular cross section is obtained. On the other end of the pencil remove approximately 13mm of wood from on half of the pencil. Install the pencil into a Sheen model 720N Pencil Scratch Hardness Tester. Follow the manufacturer's instructions for conducting the test.

2. Acceptance level: The paint finish shall withstand the abrasion of a 4H pencil without penetrating through to the substrate and completing a continuous circuit.
3. Test results: The 4H pencil did not penetrate the substrate during the test.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Furniture system installation:
 1. Install system in strict accordance with manufacturer's instructions.
 2. Set system components level on two planes with no distortion. Securely anchor to building structure using concealed shims where necessary in wall mount.

3.2 CLEANING AND PROTECTING

- A. Provide all necessary protective measures to prevent exposure of laboratory furniture system and attached components from exposure to other construction activity.
- B. Clean shop finished laboratory furniture system surfaces and touch up as required.
- C. Advise contractor of procedures and precautions for protection of the installed laboratory furniture system and related components from damage by work of other trades.

END OF SECTION 12 35 53.25

SECTION 12 36 23.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes plastic-laminate-clad countertops.

1.2 REFERENCES

- A. 06 41 16 – Plastic Laminate Faced Architectural Cabinets

1.3 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 plastic-laminate-clad countertops.
 - 1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
 - 2. Show locations and sizes of cutouts and holes for items installed in plastic-laminate-clad countertops.
 - 1. Apply AWI Quality Certification Program label to Shop Drawings.
- C. Samples for Verification: As follows:
 - 1. Plastic Laminates: For each type, color, pattern, and surface finish required, 8 by 10 inches in size.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products like 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: AWI's Quality Certification Program accredited participant.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.
- B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
- C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where countertops 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.
- C. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are 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 PLASTIC-LAMINATE-CLAD COUNTERTOPS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-clad countertops 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 countertops comply with requirements of grades specified.
- B. Grade: Custom.
- C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.
- D. Colors, Patterns, and Finishes: As indicated on drawings.
- E. Edge Treatment: Same as laminate cladding on horizontal surfaces, unless indicated otherwise.
- F. Core Material: Particleboard made with exterior glue.

- G. Core Thickness: 3/4 inch.
- H. Paper Backing: Provide paper backing on underside of countertop substrate.
- I. Laminated product must comply with CBC Section 803.11, shall have a Class C flame spread index in accordance with ASTM E84. Test specimen preparation and mounting shall be in accordance with ASTM E2579.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.
 - 1. Wood Moisture Content: 8 to 13 percent.
- B. Composite Wood and Agri fiber Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.
 - 1. Composite Wood Products: Products shall be made without urea formaldehyde.
 - 2. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.
 - 3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 - 4. Softwood Plywood: DOC PS 1.

2.3 ACCESSORIES

- A. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - 1. Outside Diameter: 2 inches.
 - 2. Color: As selected by the architect from manufacturer's full range.

2.4 MISCELLANEOUS MATERIALS

- A. Adhesives: Do not use adhesives that contain urea formaldehyde.
- B. Adhesives: Use adhesives that meet 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."
- C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.
- D. Installation Adhesive:
 - 1. Adhesives shall have a VOC content of 70 g/L or less.

2.5 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets. Ease edges to radius indicated for the following:
 - 1. Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
- C. 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 countertop 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.
- D. Shop cut openings to maximum extent possible to receive 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 cutouts by saturating with varnish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.
- B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.2 INSTALLATION

- A. Grade: Install countertops to comply with same grade as item to be installed.
- B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
 - 1. Provide cutouts for 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. Seal edges of cutouts by saturating with varnish.
- C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
1. Secure field joints in countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches variation from a straight, level plane.
 2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
 3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.
- B. Clean countertops on exposed and semi exposed surfaces.
- C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 12 36 23.13

SECTION 12 36 61.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Solid surface material countertops.
 - 2. Solid surface material backsplashes.
 - 3. Solid surface material end splashes.
- B. Related Requirements:
 - 1. Section 22 40 00 "Plumbing Fixtures" for sinks and plumbing fittings.

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
 - 1. Show locations and details of joints.
 - 2. Show direction of directional pattern, if any.
- C. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches square.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops like that required for this Project, and whose products have a record of successful in-service performance.

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- B. Installer Qualifications: Fabricator of countertops.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by, but not limited to, one of the following:
 - a. Avonite Surfaces.
 - b. Caesarstone International.
 - c. E. I. du Pont de Nemours and Company.
 - d. Formica Corporation.
 - e. Wilsonart LLC.
 - 2. Type: Provide Standard type unless Special Purpose type is indicated.
 - 3. Colors and Patterns: As indicated on drawings.

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: Custom.
- B. Configuration:
 - 1. Front: Straight, slightly eased at top; unless otherwise indicated.
 - 2. Backsplash: Straight, slightly eased at corner; unless otherwise indicated.
 - 3. End Splash: Matching backsplash.
- C. Countertops: Thickness as indicated on drawings, or if not indicated, 1/2-inch-thick minimum, solid surface material with front edge built up with same material.
- D. Backsplashes: 1/2-inch-thick, solid surface material.

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- E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
 - 2. Install integral sink bowls in countertops in the shop.
- F. Joints: Fabricate countertops without joints.
- G. Cutouts and Holes:
 - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
 - b. Provide vertical edges, rounded to 3/8-inch radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch into fixture opening.
 - c. Provide 3/4-inch full bullnose edges projecting 3/8 inch into fixture opening.
 - 2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
 - 1. Adhesives shall have a VOC content of 70 g/L or less.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten sub tops to cabinets by screwing through sub tops into corner blocks of base cabinets. Shim as needed to align sub tops in a level plane.
- D. Secure countertops to sub tops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
 - 1. Seal edges of cutouts in particleboard sub tops by saturating with varnish.
- H. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION 12 36 61.16

SECTION 12 48 13 - ENTRANCE FLOOR MATS

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. Resilient-tile entrance mats.

1.3 COORDINATION

- A. Coordinate size and location of recesses in concrete to receive floor mats and frames.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For the floor mat in manufacturer's standard sizes:

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Resilient-Tile Entrance Mats: Full-size tile units equal to 2 percent of amount installed, but no fewer than 10 units.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS, GENERAL

- A. Accessibility Standard: Comply with applicable provisions in California Building Code.

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B. Comply with California Building Code, Section 11B-302.2.

1. Carpet shall be securely attached and shall have a firm cushion, pad, or backing or no cushion or pad. It shall have a level loop, textured loop, level cut pile, or level cut/uncut pile texture.
2. Exposed edges shall be fastened to floor surfaces and shall have trim on the entire length. Carpet edge shall comply with CBC, Section 11B-303.

2.2 RESILIENT-TILE ENTRANCE MATS (WOM-01)

A. Basis-of-Design: Mohawk First Step II Tile.

B. Carpet-Type Tiles: 100% solution-dyed polypropylene or polyester fiber with synthetic backing with nonraveling edges.

1. Colors, Textures, and Patterns: As indicated on drawings, or if not indicated, Cobalt 955.
2. Tile Size: Single Door 4.5'x4.5' minimum, Double Door 7.5'x9'.0 minimum

C. Performance:

- | | |
|-----------------------------|---|
| 1. Slip resistance | Minimum static coefficient of friction of 0.6 |
| 2. Methenamine Pill Test | Passes (DOCFF-1-70) |
| 3. Radiant Panel | Class I (ASTM E-648) |
| 4. NBS Smoke | Less than 450 (ASTM-E-662) |
| 5. Electrostatic propensity | Less than 3.5 kV (AATCC-134) |

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and floor conditions for compliance with requirements for location, sizes, and other conditions affecting installation of floor mats and frames.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install surface-type units to comply with manufacturer's written instructions, coordinate with entrance locations and traffic patterns.

3.3 PROTECTION

- A. Protect installed units after installation. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 12 48 13

ENTRANCE FLOOR MATS

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SECTION 12 62 00 - FURNISHINGS AND UPHOLSTERY

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 upholstery fabrics.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples:
 - 1. Upholstery Fabric: Full width by 36-inch- (914-mm-) long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of flame-retardant treatment of upholstery fabric.

1.5 CLOSEOUT SUBMITTALS

- A. Methods for maintaining upholstery fabric.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fabric of a single dye lot for each color and pattern of fabric required.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics of Upholstery fabrics and padding materials:
 - 1. Fabric and Padding:

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- a. Fabric: Class 1 according to DOC CS 191 or 16 CFR 1610, tested according to California Technical Bulletin 117-2000.
 - b. Padding: Comply with California Technical Bulletin 117-2013.
2. Upholstery Assembly: Assembly shall comply with component-testing requirements of California Technical Bulletin 117-2013.
3. Full-Scale Fire Test: Comply with California Technical Bulletin 133.

2.3 UPHOLSTERY FABRICS (UPH-01)

- A. Basis-of-Design: Maharam Fabric Corporation
- B. Colors and patterns: Scuba 464930, 016 Sapphire
- C. All upholstery fabrics shall be flame-retardant treated as required to meet performance requirements.
- D. All upholstery fabrics shall be provided with manufacturer's standard stain resistant finish.
- E. Upholstery Padding: Flexible, cellular, molded or slab polyurethane foam.
 1. Pounding-Fatigue Performance: Grade AP (heavy-duty use) for seats and Grade BP (normal duty use) for backs; according to ASTM D3453.

2.4 FABRICATION

- A. Upholstery: Fabricate fabric-covered cushions with molded padding beneath fabric and with fabric covering free of welts, creases, stretch lines, and wrinkles. For each upholstered component, install pile and pattern run in a consistent direction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine all work where upholstery fabrics are to be installed for compliance with requirements and other conditions affecting performance of the Work.

3.2 ADJUSTING

- A. Replace upholstery fabric damaged during installation or work of other trades.

END OF SECTION 12 62 00

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Equipment installation requirements common to equipment sections.
 - 7. Concrete bases.
 - 8. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- E. Welding Filler Metals: Comply with AWS D10.12.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss,

expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

END OF SECTION 22 05 00

SECTION 22 05 19 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermometers.
 - 2. Gages.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Palmer - Wahl Instruments Inc.
 - 2. Terice, H. O. Co.
 - 3. Weiss Instruments, Inc.
 - 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Case: Die-cast aluminum or brass, 7 inches long.
- C. Tube: Red or blue reading, mercury or organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Safety Glass.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.2 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.3 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Palmer - Wahl Instruments Inc.
 - 2. Trerice, H. O. Co.
 - 3. Weiss Instruments, Inc.
 - 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - 5. Winters Instruments.
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
 - 1. Case: Liquid-filled type, drawn steel or cast aluminum, 4-1/2-inch diameter.
 - 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 - 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 - 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 - 6. Pointer: Red or black metal.
 - 7. Window: Laminated Safety Glass.
 - 8. Ring: 304 Stainless Steel.
 - 9. Accuracy: Grade B, plus or minus 1 percent of whole scale.
 - 10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 - 11. Range for Fluids under Pressure: Two times operating pressure.
- C. Pressure-Gage Fittings:
 - 1. Valves: NPS 1/4 brass or stainless-steel needle type.
 - 2. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

PART 3- EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the outlet of each domestic, hot-water storage tank.
- B. Provide the following temperature ranges for thermometers:
 - 1. Domestic Hot Water: 30 to 240 deg F, with 2-degree scale divisions.

2. Domestic Cold Water: 30 to 130 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

- A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.
- B. Install Liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- D. Install needle-valve and snubber fitting in piping for each pressure gage.
- E. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.
- F. Adjust faces of thermometers and gages to proper angle for best visibility.

END OF SECTION 22 05 19

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following general-duty valves:
 - 1. Copper-alloy ball valves.
 - 2. Bronze gate valves.
- B. See Division 21 fire-suppression piping and fire pump Sections for fire-protection valves.
- C. See Division 22 piping Sections for specialty valves applicable to those Sections only.

1.2 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; furnished specialties; and accessories.

1.3 QUALITY ASSURANCE

- A. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and Smaller: Threaded ends, unless otherwise indicated.
- C. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- D. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- E. Valve Actuators:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
- F. Extended Valve Stems: On insulated valves.
- G. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- H. Valve Grooved Ends: AWWA C606.
 - 1. Solder Joint: With sockets according to ASME B16.18.
 - a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
 - 2. Threaded: With threads according to ASME B1.20.1.
- I. Valve Bypass and Drain Connections: MSS SP-45.

2.3 COPPER-ALLOY BALL VALVES

- A. Manufacturers:
 - 1. Two-Piece, Copper-Alloy Ball Valves:
 - a. Conbraco Industries, Inc.; Apollo Div.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Industries, Inc.; Water Products Div.
- B. Copper-Alloy Ball Valves, General: MSS SP-110.

- C. Two-Piece, Copper-Alloy Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.

2.4 BRONZE GATE VALVES

A. Manufacturers:

1. Type 2, Bronze, Rising-Stem, Solid-Wedge Gate Valves:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Hammond Valve.
- c. Milwaukee Valve Company.
- d. NIBCO INC.

B. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.

- C. Type 2, Class 150, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge and union-ring bonnet.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:

- 1. Shutoff Service: Ball or gate valves.
- 2. Throttling Service: Ball valves.

- B. If valves with specified CWP ratings are not available, the same types of valves with higher CWP ratings may be substituted.

- C. Domestic Water Piping: Use the following types of valves:

- 1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
- 2. Gate Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.

- D. Select valves, except wafer and flangeless types, with the following end connections:

- 1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends.
- 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
- 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
- 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded ends.

3.2 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.4 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 22 05 23

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. See Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- C. See Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Equipment supports.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.
 - 7. Globe Pipe Hanger Products, Inc.
 - 8. Grinnell Corp.
 - 9. GS Metals Corp.
 - 10. National Pipe Hanger Corporation.
 - 11. PHD Manufacturing, Inc.
 - 12. PHS Industries, Inc.

13. Piping Technology & Products, Inc.
14. Tolco Inc.

- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. Tolco Inc.
 3. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 1. Carpenter & Paterson, Inc.
 2. ERICO/Michigan Hanger Co.
 3. PHS Industries, Inc.
 4. Pipe Shields, Inc.
 5. Rilco Manufacturing Company, Inc.
 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 - 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 22 05 29

SECTION 22 05 48 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Freestanding and restrained spring isolators.
 - 5. Housed spring mounts.
 - 6. Elastomeric hangers.
 - 7. Spring hangers.
 - 8. Spring hangers with vertical-limit stops.
 - 9. Pipe riser resilient supports.
 - 10. Resilient pipe guides.
 - 11. Seismic snubbers.
 - 12. Restraining braces and cables.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. In accordance with Section 1632 of Table 126-0 of Volume 2, Title 24, 2016.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated in accordance with Section 1632 of Table 126-0 of Volume 2, Title 24, 2016

- b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 - 4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By OSHPD an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Coordination Drawings: Show coordination of seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.
- E. Qualification Data: For professional engineer and testing agency.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the CBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPM number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. California Dynamics Corporation.
 - 2. Isolation Technology, Inc.
 - 3. Mason Industries.
 - 4. Vibration Isolation.
- B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.
- C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

- D. Restrained Mounts: All-directional mountings with seismic restraint.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.
- H. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- I. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- J. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- K. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- L. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. California Dynamics Corporation.

2. Isolation Technology, Inc.
 3. Mason Industries.
 4. Vibration Isolation.
- B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.3 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Cooper B-Line, Inc.; a division of Cooper Industries.
 2. Hilti, Inc.
 3. Mason Industries.
 4. TOLCO Incorporated; a brand of NIBCO INC.
 5. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by OSHPD an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

- C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 - 3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.
- D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- E. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.4 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.

2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by OSHPD an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment Restraints:
 1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches.
 3. Install seismic-restraint devices using methods approved by OSHPD an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Piping Restraints:
 1. Comply with requirements in MSS SP-127.

2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 3. Brace a change of direction longer than 12 feet.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install seismic-restraint devices using methods approved by OSHPD an agency acceptable to authorities having jurisdiction providing required submittals for component.
- E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- H. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 15 Section "Domestic Water Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
10. Air-Mounting System Operational Test: Test the compressed-air leveling system.
11. Test and adjust air-mounting system controls and safeties.
12. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of sprint isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 22 05 48

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel self-tapping screws.
 - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White Yellow Insert color.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Fiberboard.
 - 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.

- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 9 Section "Interior Painting."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Condensate Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
2. Natural Gas Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
3. Domestic Water Piping:
 - a. Background Color: Black.
 - b. Letter Color: Yellow.
4. Sanitary Waste, Vent and Storm Drainage Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 1. Valve-Tag Size and Shape:
 - a. Cold Water: 2 inches, round.
 - b. Hot Water: 2 inches, round.
 2. Valve-Tag Color:
 - a. Cold Water: Natural.
 - b. Hot Water: Natural.
 3. Letter Color:
 - a. Cold Water: Black.
 - b. Hot Water: Black.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:
 - a. Mineral fiber.
2. Insulating cements.
3. Adhesives.
4. Sealants.
5. Factory-applied jackets.
6. Tapes.
7. Securements.

B. Related Sections include the following:

1. Division 23 Section "HVAC Insulation."

1.2 SUBMITTALS

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

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
3. Detail removable insulation at piping specialties, equipment connections, and access panels.

C. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and

jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Mineral-Fiber, Preformed Pipe Insulation:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000 Pipe Insulation.
 - c. Owens Corning; Fiberglas Pipe Insulation.
 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.

2.4 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
- B. Available ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.6 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.7 SECUREMENTS

- A. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.6 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
 2. Underground piping.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.7 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water: Insulation shall be the following:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

END OF SECTION 22 07 00

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes domestic water piping inside the building.
- B. Water meters will be furnished and installed by utility company.
- C. See Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and fittings.
- D. See Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.2 SUBMITTALS

- A. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- C. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.

3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.2 VALVES

- A. Bronze and cast-iron, general-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Balancing and drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPE AND FITTING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-Building-Slab, Water-Service Piping on Service Side of Water Meter: Refer to Division 22 Section "Facility Water Distribution Piping."
- E. Domestic Water Piping on Service Side of Water Meter inside the Building: Use the following piping materials for each size range:
 1. NPS 4 to NPS 6: Hard copper tube, Type L; copper pressure fittings; and soldered joints.
- F. Under-Building-Slab, Domestic Water Piping on House Side of Water Meter, NPS 4 and Smaller: Hard copper tube, Type K; copper pressure fittings; and soldered joints.
- G. Aboveground Domestic Water Piping: Use the following piping materials for each size range:
 1. NPS 1 and Smaller: Hard copper tube, Type L; copper pressure fittings; and soldered joints.

3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use bronze ball valves for piping NPS 2 and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 - 2. Throttling Duty: Use bronze ball valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
 - 3. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
 - 2. Install stop-and-waste drain valves where indicated.
- D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

3.4 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."
- C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure gages are specified in Division 22 Section "Meters and Gages for Plumbing Piping," and drain valves and strainers are specified in Division 22 Section "Domestic Water Piping Specialties."
- E. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

3.5 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.6 ROUGHING-IN FOR WATER METERS

- A. Rough-in domestic water piping for water meter installation according to utility company's requirements.
- B. Water meters will be furnished and installed by utility.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support devices are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.

- F. Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

- A. Install piping adjacent to equipment and machines to allow service and maintenance.
- B. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- C. Connect domestic water piping to water-service piping with shutoff valve, and extend and connect to the following:
 - 1. Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
 - 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.10 CLEANING

- A. Clean and disinfect potable domestic water piping using purging and disinfecting procedures prescribed by authorities having jurisdiction.
- B. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.

END OF SECTION 22 11 16

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Hose bibbs.
 - 3. Water hammer arresters.
 - 4. Trap-seal primer valves.
- B. See Division 22 Section "Domestic Water Piping" for water meters.
- C. See Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

1.5 VACUUM BREAKERS

A. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago Faucets
 - b. Arrowhead Brass Products, Inc.
 - c. MIFAB, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Light Commercial Operation.
 - f. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1001.
3. Body: Bronze, non-removable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

1.6 HOSE BIBBS

A. Hose Bibbs HB-1 and HB-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: (Refer to plans for model number)
 - a. Acorn Engineering
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Divisions of Smith Industries, Inc.
 - d. Zurn Plumbing Products Group; Light Commercial Operation.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough chrome finish.
10. Finish for Service Areas: Rough chrome finish.
11. Finish for Finished Rooms: Polished chrome finish.
12. Operation for Equipment Rooms: Operating key.
13. Operation for Service Areas: Operating key.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.

16. Include wall flange with each chrome- or nickel-plated hose bibb.

1.7 WATER HAMMER ARRESTERS

A. Water Hammer Arresters WHA-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: (Refer to plans for model number)
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. MIFAB, Inc.
 - c. AMTROL, Inc.
 - d. Josam Company.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

1.8 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves TP-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: (Refer to plans for model number)
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. MIFAB, Inc.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. PPP. Inc.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 2 - EXECUTION

2.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- E. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve,.
- F. Install water hammer arresters in water piping according to PDI-WH 201.
- G. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- H. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- I. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Reduced-pressure-principle backflow preventers.
 - 2. Double-check backflow-prevention assemblies.
 - 3. Water pressure-reducing valves.
 - 4. Primary, thermostatic, water mixing valves.
 - 5. Supply-type, trap-seal primer valves.
- J. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

2.2 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principle backflow preventer and double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

2.3 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 11 19

SECTION 22 11 23 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig (690 kPa) minimum unless otherwise indicated.
- B. Natural-Gas System Pressure within Buildings: 0.5 psig (3.45 kPa) or less.

1.5 SUBMITTALS

- A. The contractor shall submit complete data as hereinafter specified. Said data, assembled in individual brochures, shall be submitted in seven (7) copies. Each item shall be identified by the

paragraph number and page number as shown in the Specifications. Brochures shall be clearly labeled with project name and Architectural project number. Should corrections be necessary, the Contractor shall resubmit within fifteen (15) calendar days after the submittals are returned by the Architect

B. Product Data: For each type of the following:

1. Piping specialties.
2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- 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.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- C. Protect stored PE pipes and valves from direct sunlight.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
 1. Notify Architect Construction Manager Owner no fewer than five (5) working days in advance of proposed interruption of natural-gas service.
 2. Do not proceed with interruption of natural-gas service without Architect's Construction Manager's and Owner's written permission.

1.9 COORDINATION

- A. Coordinate sizes and locations of actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
 - 5. Corrosion Control: Refer to Soil Corrosivity Study and Report for further requirements.
- B. PE Pipe: ASTM D 2513, SDR 11.
 - 1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
 - 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

2.2 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 - 4. Corrugated stainless-steel tubing with polymer coating.
 - 5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
 - 6. End Fittings: Zinc-coated steel.
 - 7. Threaded Ends: Comply with ASME B1.20.1.
 - 8. Maximum Length: 72 inches ((1830 mm)).

2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
 - 1. CWP Rating: 200 psig (862 kPa).
 - 2. Threaded Ends: Comply with ASME B1.20.1.
 - 3. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
 - 4. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
 - 1. CWP Rating: 200 psig (862 kPa).
 - 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 - 3. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Bronze Plug Valves: MSS SP-78.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead.
 - b. Walworth.
 - 2. Body: Bronze, complying with ASTM B 584.
 - 3. Plug: Bronze.
 - 4. Ends: Threaded, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 5. Operator: Square head or lug type with tamperproof feature where indicated.
 - 6. Pressure Class: 200 psig.
 - 7. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Walworth.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type.
8. Pressure Class: 200 psig.
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches (125 mm) in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.5 EARTHQUAKE VALVES

A. Earthquake Valves: Comply with ASCE 25.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following: (Refer to plans for model number)
 - a. KOSO.
 - b. Pacific Seismic Products, Inc.
3. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
4. Maximum Operating Pressure: 0.5 psig (3.45 kPa).
5. Cast-aluminum body with stainless-steel internal parts.
6. Nitrile-rubber, reset-stem o-ring seal.
7. Valve position, open or closed, indicator.
8. Composition valve seat with clapper held by spring or magnet locking mechanism.
9. Level indicator.
10. End Connections: Threaded for valves NPS 2 (DN 50) and smaller; flanged for valves NPS 2-1/2 (DN 65) and larger.

2.6 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.7 ESCUTCHEONS

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.
- B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Escutcheons: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Escutcheons: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Escutcheons: With exposed-rivet hinge, set screw, and chrome-plated finish.
- G. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

2.8 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 24 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Install fittings for changes in direction and branch connections.
- E. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.

3.4 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install escutcheons at penetrations of interior walls, ceilings, and floors.

1. New Piping:

- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - d. Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Piping in Unfinished Service Spaces: One-piece, stamped-steel type with exposed-rivet hinge and set screw.
 - f. Piping in Equipment Rooms: One-piece, cast-brass type.
 - g. Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
 - h. Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
 - L. Verify final equipment locations for roughing-in.
 - M. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
 - N. Conceal pipe installations in walls, pipe spaces and, utility spaces, above ceilings.

1. Prohibited Locations:

- a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- O. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- P. Connect branch piping from top or side of horizontal piping.
- Q. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- R. Do not use natural-gas piping as grounding electrode.

3.5 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install earthquake valves outside buildings according to listing.
- D. Install anode for metallic valves in underground PE piping.

3.6 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.

3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
 2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
 4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).
 5. NPS 4 (DN 100) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 5/8 inch (15.8 mm).

3.8 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install piping adjacent to appliances to allow service and maintenance of appliances.
- C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

3.9 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.10 PAINTING

- A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping and valves, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 - 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 (flat).
 - d. Color: Gray.
- C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.12 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be the following:
 - 1. PE pipe and fittings joined by heat fusion; service-line risers with tracer wire terminated in an accessible location.
- B. Aboveground natural-gas piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.

3.13 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

- A. Aboveground, branch piping 2 inch and smaller shall be the following:
 - 1. Schedule 40 Black Steel pipe with #150 Black Banded malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be the following:
 - 1. Schedule 40 Black Steel pipe with #150 Black Banded malleable-iron fittings and threaded joints.

- C. Piping Under buildings; NOT Permitted
- D. Galvanized steel pipe and fittings shall NOT be used.

3.14 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.
- B. Underground:
 - 1. PE valves.
 - 2. NPS 2 (DN 50) and Smaller: Bronze plug valves.
 - 3. NPS 2-1/2 (DN 65) and Larger: Cast-iron, lubricated plug valves.

3.15 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 (DN 50) and smaller at service meter shall be the following:
 - 1. Semi-steel Lubricated plug valve.
- B. Valves for pipe sizes NPS 2-1/2 (DN 65) and larger at service meter shall be the following:
 - 1. Semi-Steel flanged plug valve.
- C. Distribution piping valves for pipe sizes NPS 2 (DN 50) and smaller shall be the following:
 - 1. Semi-Steel lubricated plug valve.
- D. Distribution piping valves for pipe sizes NPS 2-1/2 (DN 65) and larger shall be the following:
 - 1. Semi-steel flanged, lubricated plug valve.
- E. Valves in branch piping for single appliance shall be the following:
 - 1. Bronze plug valve.

END OF SECTION 22 11 23

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following for soil, waste, vent and condensate piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.
- B. Video taped sanitary waste piping

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.
- B. Flat Work: Concrete walks, concrete driveways, and asphalt paving.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 5 P.S.I.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A888-13 including Annex A1 from accredited ANSI inspection agency or CISPI 301-12 including Annex A1 from accredited ANSI inspection agency.
 - 1. Hubless Cast-Iron Soil Pipe
 - a. Manufacturers:
 - 1) A, B & I Foundry.
 - 2) Tyler Pipe & Coupling
 - 3) Charlotte Pipe and Foundry Company
 - 2. Heavy-Duty, Shielded, Stainless-Steel Couplings (Above Ground Use): With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Manufacturers:

- 1) ANACO-HUSKY.
 - 2) Tyler Pipe; Soil Pipe Div.
 - 3) Mission Rubber Co.
 - 4) Clamp-All Corp.
3. Heavy -Duty, Cast-Iron Couplings (Below Grade Use): ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
- a. Manufacturers:
 - 1) ANACO-HUSKY.

2.4 COPPER PIPE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Types L tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings.

2.5 PVC PIPE AND FITTINGS:

- A. Comply with NSF 14, "Plastic Piping Systems Components and Related Materials" for plastic piping components. Include markings with "NSF-DWV" for plastic drain, waste and vent, and "NSF=sewer" for plastic sewer piping
- B. Solid-Wall PVC Pipe: ASTM D2665, drain, waste and vent.
- C. Cellular-Core PVC Pipe: ASTM F891, Schedule 40.
- D. PCV Socket Fittings: ASTM D2665, made of ASTM D3311, drain, waste, and vent patterns and fit to Schedule 40 pipe.
- E. Adhesive Primer: ASTM F656.
- F. Solvent Cement: ASTM D2564

2.6 SPECIAL PIPE FITTINGS

- G. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
1. Manufacturers:
- a. Cascade Waterworks Mfg. Co.
 - b. Mission Rubber Co.

- H. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

- 1. Manufacturers:

- a. ANACO.

- I. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

- 1. Manufacturers:

- a. SIGMA Corp.

2.7 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch minimum thickness.
- B. Form: Sheet.
- C. Color: Black.
- D. Corrosion Control: Refer to Soil Corrosivity Study and Report for further requirements.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:
 - 1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 2. Steel pipe, drainage fittings, and threaded joints.
- B. Aboveground, soil and waste piping NPS 5 and larger shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Steel pipe, drainage fittings, and threaded joints.
- C. Aboveground, vent piping NPS 4 and smaller shall be the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Steel pipe, drainage fittings, and threaded joints.
- D. Aboveground, vent piping NPS 5 and larger shall be the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Steel pipe, drainage fittings, and threaded joints.
- E. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:
1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, cast-iron couplings; and hubless-coupling joints.
- F. Underground, soil and waste piping NPS 5 and larger shall be the following:
1. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, cast-iron couplings; and hubless-coupling joints.
- G. Condensate Piping: Type L hard drawn copper pipe with wrought copper solder fittings and couplings.

3.3 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Division 33.
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install seismic restraints on piping. In accordance with Mason Seismic restraints guidelines.
- D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

- F. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
 - G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
 - H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
 - I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
 - J. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
 - K. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - L. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
 - M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - N. All interior condensate piping shall be insulated with closed cell foam insulation: with FHC 25/50 composite rating.
- 3.4 JOINT CONSTRUCTION
- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
 - B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

- C. All joints of buried hubless cast iron pipe and cast iron couplings shall be field wrapped.
 - 1. Prior to wrapping, fittings and field joints shall be washed with a non-oily solvent and then cleaned with a wire brush. After cleaning, fittings and field joints shall be coated and wrapped as follows:
 - a. Coat of Koppers "Jet-Set" coal tar primer, applied uniformly to dry surfaces.
 - b. Two layers of 2" wide 35 mils thick Polyken 931 black butyl rubber molding tape with 1" lap, covered with one layer of 3/4" wide 15 mils thick Polyken 930 black polyethylene pressure sensitive tape with 1/4" lap.
 - c. Field wrapping shall extend 3 inches beyond joint.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6: 60 inches with 3/4-inch rod.
 - 5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
- G. Install supports for vertical cast-iron soil piping every 15 feet.

- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 - 7. NPS 6: 12 feet with 3/4-inch rod.
 - 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- I. Install supports for vertical steel piping every 15 feet.
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Interruption of Existing Sanitary Waste System: Do not interrupt Existing Sanitary Waste System to facilities occupied by Owner or others unless permitted under the following conditions:
 - 1. Notify Architect, Construction Manager, and Owner no fewer than seven (7) days in advance of proposed interruption.
 - 2. Do not proceed with interruption without Architect's Construction Manager's and Owner's written permission.
- B. Drawings indicate general arrangement of piping, fittings, and specialties.
- C. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- D. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
- E. Connect condensate to equipment with pipe sizes as indicated, but in no case shall the piping be smaller than the equipment condensate pipe size.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in for not less than one hour. Close openings in piping system and fill with water to point of overflow, but not less than 5 P.S.I.; water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 VIDEO TAPED SANITARY WASTE PIPING

- A. Video taping shall include new and existing waste piping, and limited to the path of travel of the waste from the new construction to where the street main connection occurs.
- B. All three (3) inch and larger piping shall be subjected to video taping.
- C. The video taping shall occur after all testing of sanitary waste piping has been completed, and before flat work, such as concrete walks, and asphalt, has been installed.
- D. Film: The taping shall be provided on high resolution color film that can be displayed on a common VHS recorder.
- E. Record Drawings: The Contractor shall obtain a reproducible drawing from the Architect. The drawing shall provide accurate dimensioned record of routing of the system piping with invert elevations. Irregularities encountered such as obstructions in the pipe, broken pipe or piping that were installed differently from that shown on the drawings shall be identified, dimensioned and provided with invert elevations.
 - 1. Encountered irregularities shall be reported to the plumbing Contractor for rectification. After encountered irregularities have been corrected the Architect shall have the right to request one additional visit from the contractor performing the video recording.
 - 2. The video and the drawing are deemed to be complementary.
 - 3. Before formal acceptance of the video tape and the drawing, both items shall be delivered to the On-Site Inspector for his review. The drawings will be signed by the Inspector before being delivered to the Architect.
 - 4. If in the opinion of the Architect the record drawing is not legible or the video and the drawing are not complementary the Video Taping Contractor shall employ a satisfactory draftsman to properly perform this work.

END OF SECTION 22 13 16

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Miscellaneous sanitary drainage piping specialties.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Zurn Plumbing Products Group; Specification Drainage Operation.
 - c. MIFAB, Inc.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

- B. Cast-Iron Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Zurn Plumbing Products Group; Specification Drainage Operation.
 - c. MIFAB
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Threaded.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Polished bronze.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Light Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Zurn Plumbing Products Group; Specification Drainage Operation.
 - c. MIFAB, Inc.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, drilled-and-threaded plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains FD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: (Refer to plans for model number)
 - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - b. Zurn Plumbing Products Group; Specification Drainage Operation.
 - c. MIFAB, Inc.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.

4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Top or Strainer Material: Nickel bronze.
10. Top of Body and Strainer Finish: Nickel bronze.
11. Top Shape: Round.
12. Top Loading Classification: Light Duty.
13. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
14. Trap Material: Cast iron.
15. Trap Pattern: Standard P-trap.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.

- c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
- 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- G. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.
- C. Corrosion Control: Refer to Soil Corrosivity Study and Report for further requirements.

END OF SECTION 22 13 19

SECTION 22 14 13 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following storm drainage piping inside the building.

1. Pipe, tube, and fittings.
2. Special pipe fittings.

1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

1.3 SUBMITTALS

- A. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping.

PART 2 – PRODUCTS

2.1 CAST -IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A888-13 including Annex A1 from accredited ANSI inspection agency or CISPI 301-12 including Annex A1 from accredited ANSI inspection agency.

1. Hubless Cast-Iron Soil Pipe
 - a. Manufacturers:
 - 1) A, B & I Foundry.

- 2) Tyler Pipe & Coupling
 - 3) Charlotte Pipe and Foundry Company
- 2. Heavy-Duty, Shielded, Stainless-Steel Couplings (Above Ground Use): With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) ANACO-HUSKY.
 - 2) Tyler Pipe; Soil Pipe Div.
 - 3) Mission Rubber Co.
 - 4) Clamp-All Corp.
- 3. Heavy -Duty, Cast-Iron Couplings (Below Grade Use): ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) ANACO-HUSKY.

2.2 PVC PIPE AND FITTINGS:

- A. Comply with NSF 14, "Plastic Piping Systems Components and Related Materials" for plastic piping components. Include markings with "NSF-DWV" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D2665, drain, waste, and vent.
- C. Cellular-Core PCS Pipe: ASTM F891, Schedule 40.
- D. PVC Socket Fittings: ASTM D2665, made of ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- E. Adhesive Primer: ASTM F656.
- F. Solvent Cement: ASTM D2564.

2.3 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Description: ASTM A 674 or AWWA C105, high-density, cross-laminated PE film of 0.004-inch minimum thickness.
- B. Form: Sheet.
- C. Color: Black.
- D. Corrosion Control: Refer to Soil Corrosivity Study and Report for further requirements.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Aboveground storm drainage piping NPS 4 and smaller shall be the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.
- C. Underground storm drainage piping NPS 4 and smaller shall be the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and coupled joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.

3.2 PIPING INSTALLATION

- A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- D. Install wall-penetration-fitting system at each service pipe penetration through foundation wall. Make installation watertight.
- E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- F. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- G. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install

required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

- H. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.
- I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.

3.5 CONNECTIONS

- A. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect storm drainage piping to roof drains and storm drainage specialties.

3.6 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping according to procedures of authorities having jurisdiction.

3.7 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 14 13

SECTION 22 14 23 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following storm drainage piping specialties:

1. Roof drains.
2. Miscellaneous storm drainage piping specialties.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 ROOF DRAINS

- A. Cast-Iron Roof Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Smith, Jay R. Mfg. Co.; or a comparable product by one of the following: (Refer to plans for model number)
 - a. Josam Company; Josam Div.
 - 1) Roof Drain (RD-1): 15" diameter with hubless cast iron body with bottom outlet, flashing ring, underdeck clamp, sump receiver gravel stop and cast iron dome strainer with vandelproof mounting.
 - 2) ASME A112.21.2M

2.2 OVERFLOW DRAINS

- A. Cast-Iron Overflow Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Smith, Jay Mfg. Co. or a comparable product by one of the following; (Refer to plans for model number)

a. Josam Company, Josam Div.

- 3) Overflow Drain (OD-1): 15" diameter assembly with hubless cast iron body with bottom outlet, 2" high water dam, flashing ring, underdeck clamp, sump receiver and cast iron dome strainer with vandalproof mounting.
- 4) ASME A112.21.2M

2.3 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Boots:

1. Description: ASTM A 74, Service class, hub-and-spigot, cast-iron soil pipe.
2. Size: Same as or larger than connected downspout.

B. Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roof materials are specified in Division 07.
 1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 2. Position roof drains for easy access and maintenance.
- C. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- D. Install cast-iron soil pipe downspout boots at grade with top of hub 12 inches above grade.
- E. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- F. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.
- C. Corrosion Control: Refer to Soil Corrosivity Study and Report for further requirements.

END OF SECTION 22 14 23

SECTION 22 33 00 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

1. Commercial, light-duty, storage, electric, domestic-water heaters.
2. Domestic-water heater accessories.

1.2 SUBMITTALS

- A. Product data: for each type and size of domestic-water heater indicated.
- B. Shop drawings:
 1. Wiring diagrams: for power, signal, and control wiring.
- C. Seismic qualification certificates: for commercial domestic-water heaters, accessories, and components, from manufacturer.
- D. Domestic-water heater labeling: certified and labeled by testing agency acceptable to authorities having jurisdiction.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Operation and maintenance data.
- H. Warranty: sample of special warranty.

1.3 QUALITY ASSURANCE

- A. Electrical components, devices, and accessories: listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA 90.1 compliance: applicable requirements in ASHRAE/IESNA 90.1.
- C. ASME compliance: where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME boiler and pressure vessel code: section viii, division 1.

- D. NSF compliance: fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "drinking water system components - health effects."

1.4 WARRANTY

- A. Special warranty: manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Warranty periods: from date of substantial completion.
 - a. Commercial, light-duty, storage, electric, domestic-water heaters:
 - 1) Storage tank: three years.
 - 2) Controls and other components: two years.

PART 2 - PRODUCTS

- A. COMMERCIAL, LIGHT-DUTY, STORAGE, ELECTRIC, DOMESTIC-WATER HEATERS:

1. Manufacturers: subject to compliance with requirements, provide products by one of the following:
2. Basis-of-design product: subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Bradford white corporation.
 - b. Lochinvar corporation.
 - c. Smith, a. O. Water products co.; a division of a. O. Smith corporation.
3. Standard: ul 174.
4. Storage-tank construction: steel, vertical arrangement.
 - a. Tappings: ASME b1.20.1 pipe thread.
 - b. Pressure rating: 150 psig.
 - c. Interior finish: comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.
5. Factory-installed storage-tank appurtenances:
 - a. Anode rod: replaceable magnesium.
 - b. Dip tube: required unless cold-water inlet is near bottom of tank.
 - c. Drain valve: ASSE 1005.
 - d. Insulation: comply with ASHRAE/IESNA 90.1.
 - e. Jacket: steel with enameled finish.
 - f. Heat-trap fittings: inlet type in cold-water inlet and outlet type in hot-water outlet.
 - g. Heating elements: two; electric, screw-in immersion type; wired for simultaneous operation unless otherwise indicated. Limited to 12 kw total.
 - h. Temperature control: adjustable thermostat.

- i. Safety control: high-temperature-limit cutoff device or system.
 - j. Relief valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.
 - 6. Special requirements: NSF 5 construction with legs for off-floor installation.
 - B. Capacity and characteristics:
 - 1. Listed on schedule.
 - 2. Electrical characteristics:
 - a. Listed on schedule.
- 2.2 DOMESTIC-WATER HEATER ACCESSORIES
- A. Domestic-water compression tanks:
 - 1. Manufacturers: subject to compliance with requirements, provide products by one of the following:
 - 2. Basis-of-design product: subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Amtrol Inc.
 - b. Smith, a. O. Water products co.; a division of a. O. Smith corporation.
 - c. Taco, Inc.
 - 3. Description: steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
 - 4. Construction:
 - a. Tappings: factory-fabricated steel, welded to tank before testing and labeling. Include ASME b1.20.1 pipe thread.
 - b. Interior finish: comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-charging valve: factory installed.
 - 5. Capacity and characteristics:
 - a. Listed on schedule
 - B. Drain pans: corrosion-resistant metal with raised edge. Comply with ANSI/CSA Ic 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than nps 3/4 with ASME b1.20.1 pipe threads or with ASME b1.20.7 garden-hose threads.

- C. Pressure-reducing valves: ASSE 1003 for water. Set at 25-psig- maximum outlet pressure unless otherwise indicated.
- D. Combination temperature-and-pressure relief valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- E. Pressure relief valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.
- F. Vacuum relief valves: ANSI z21.22/CSA 4.4.
- G. Shock absorbers: ASSE 1010 or PDI-WH 201, size a water hammer arrester.
- H. Domestic-water heater mounting brackets: manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

- A. Factory tests: test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME boiler and pressure vessel code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in division 01 section "quality requirements" for retesting and reinspecting requirements and division 01 section "execution" for requirements for correcting the work.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, electric, domestic-water heater mounting: install commercial, electric, domestic-water heaters as indicated.
 - 1. Maintain manufacturer's recommended clearances.
 - 2. Arrange units so controls and devices that require servicing are accessible.
- B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in division 22 section "general-duty valves for plumbing piping."
- C. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in division 22 section "vibration and seismic controls for plumbing piping and equipment."
- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in division 22 section "domestic water piping specialties."
- G. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in division 22 section "meters and gages for plumbing piping."
- H. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- I. Fill electric, domestic-water heaters with water.
- J. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in division 22 section "domestic water piping." drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 Identification

- A. Identify system components. Comply with requirements for identification specified in division 22 section "identification for plumbing piping and equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's field service: engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 2. LEAK TEST: AFTER INSTALLATION, CHARGE SYSTEM AND TEST FOR LEAKS. REPAIR LEAKS AND RETEST UNTIL NO LEAKS EXIST.
 - 3. OPERATIONAL TEST: AFTER ELECTRICAL CIRCUITRY HAS BEEN ENERGIZED, START UNITS TO CONFIRM PROPER OPERATION.
 - 4. TEST AND ADJUST CONTROLS AND SAFETIES. REPLACE DAMAGED AND MALFUNCTIONING CONTROLS AND EQUIPMENT.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in division 01 section "quality requirements" for retesting and reinspecting requirements and division 01 section "execution" for requirements for correcting the work.
- C. Prepare test and inspection reports.

END OF SECTION 22 33 00

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Faucets for lavatories and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Water closets.
7. Urinals.
8. Lavatories.
9. Sinks.
10. Showers
11. Service sinks.

B. Related Sections include the following:

1. Division 22 Section "Drinking Fountains and Water Coolers."

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

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

- B. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements for fixtures for people with disabilities. 2016 CBC & 2010 ADA standards.
- C. Regulatory Requirements
 - 1. Plumbing fixtures and accessories provided in a toilet room or bathing room required to comply with CBC Section 11B-213.2 shall comply with CBC Section 11B-213.3.
 - 2. Effective March 1, 2017, all single-user toilet facilities shall be identified as Gender Neutral facilities by a door symbol that complies with Section 11B-216.8 and 11B703.7.2.6.3. No pictogram, text or braille is required on the symbol. If tactile jamb signage is provided, the signage shall comply with the appropriate technical requirements of Section 11B-703. Examples of appropriate designations are "ALL GENDER RESTROOM", "RESTROOM" OR "UNISEX RESTROOM". DSA BU 17-01.
 - 3. Accessible plumbing fixtures shall comply with all the requirements in CBC Division 6.
 - 4. Clearance around accessible water closets and in toilet compartments shall be 60 inches minimum measured perpendicular from the side wall and 56 inches minimum measured perpendicular from the rear wall per CBC Section 11B-604.3.1.
 - 5. Heights and location of all accessible fixtures shall be mounted according to CBC Section 11B-602 through 11B-612.
 - 6. Accessible fixture controls shall comply with CBC Section 11B-602.3 for drinking fountains, 11B-604.6 for water closets, 11B-604.9.5 for children's water closet, 11B-605.4 for urinals, 11B-606.4 for lavatories and sinks, 11B-607.5 for bathtubs, 11B-608.5 for showers, and 11B-611.3 for washing machines and clothes for dryers.
 - 7. Accessible lavatories and sinks shall be mounted with the front of the higher rim or counter surface 34" maximum above the finish floor or ground. Depth of lavatories or sinks shall not interfere with knee and toe clearance provided in accordance with CBC Section 11B-306 when a forward approach is required. CBC Section 11B-606.3 and 11B-606.7
 - 8. Water supply and drain pipes under accessible lavatories and sinks be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under accessible lavatories and sinks. CBC Section 11B-606.5
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 4. Vitreous-China Fixtures: ASME A112.19.2M.
 5. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 6. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 4. Faucets: ASME A112.18.1.
 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 8. NSF Potable-Water Materials: NSF 61.
 9. Pipe Threads: ASME B1.20.1.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Supply Fittings: ASME A112.18.1.
 12. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Manual-Operation Flushometers: ASSE 1037.
 4. Brass Waste Fittings: ASME A112.18.2.
- J. Fixture controls shall comply with CBC section; 11B-608.5 for showers, 11B-606.4 for lavatories, 11B-604.6 for toilets and 11B-605.4 for Urinals.
1. Disposers: ASSE 1008 and UL 430.
 2. Flexible Water Connectors: ASME A112.18.6.
 3. Grab Bars: ASTM F 446.
 4. Hose-Coupling Threads: ASME B1.20.7.
 5. Off-Floor Fixture Supports: ASME A112.6.1M.
 6. Pipe Threads: ASME B1.20.1.
 7. Plastic Toilet Seats: ANSI Z124.5.
 8. Supply and Drain Protective Shielding Guards: 2016 CBC & 2010 ADA Standards.

PART 2 - PRODUCTS

2.1 SINK FAUCETS

- A. Sink Faucets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Chicago Faucets or a comparable product by one of the following: (Refer to plans for model number)
 - a. Delta Faucet Company
2. Description: Kitchen faucet with spray, three-hole fixture Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - a. Body Material: Commercial, solid brass.
 - b. Finish: Polished chrome plate.
 - c. Maximum Flow Rate: 1.5 gpm, unless otherwise indicated.
 - d. Mixing Valve: Two-lever handle.
 - e. Centers: 4 inches.
 - f. Mounting:
 - g. Handle(s):
 - h. Spout Type: Rigid, solid brass.
 - i. Spout Outlet: Aerator.
 - j. Drain: Grid offset tailpiece. Just

2.2 FLUSHOMETERS

A. Flushometers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sloan Optima Plus or a comparable product by one of the following: (Refer to plans for model number)
 - a. Zurn Plumbing Products Group; Commercial Brass Operation.
2. Description: Flushometer for water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design: Diaphragm operation.
 - b. Style: Exposed.
 - c. Inlet Size: NPS 1.
 - d. Trip Mechanism: Battery Operated, Sensor Activated.
 - e. Consumption: 1.28 gal./flush.
3. Tailpiece Size: NPS 1 ½ and standard

2.3 TOILET SEATS

A. Toilet Seats:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings Beneke or a comparable product by one of the following: (Refer to plans for model number)
 - a. Church Seats.
4. Description: Toilet seat for water-closet-type fixture.
 - a. Material: Molded, solid plastic.
 - b. Configuration: Open front without cover.
 - c. Size: Elongated.
 - d. Hinge Type: SS, self-sustaining.
 - e. Class: Standard commercial.
 - f. Color: White.

2.4 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Plumberex Specialty Products Inc.
 - b. TRUEBRO, Inc.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ACC) requirements.

2.5 FIXTURE SUPPORTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Smith, Jay R. Mfg. Co.
 2. MIFAB Manufacturing Inc.
 3. Zurn Plumbing Products Group; Specification Drainage Operation.
- C. Urinal Supports:

1. Description: Type II, urinal carrier with hanger and bearing plates for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Lavatory Supports:

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.6 WATER CLOSETS

A. Water Closets, WC-1, WC-2 (ACC):

1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard "Madera" vitreous china and Acorn stainless steel as indicate on drawings or a comparable product by one of the following: (Refer to plans for model number).
 - a. Kohler Co.
 - b. Bradley.
 - c. Or approved equal.
2. Description: Accessible, floor-mounting, floor-outlet, designed for flushometer valve operation.
3. Style: Flushometer valve.
 - a. Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
 - b. Height: Standard and Accessible (See Drawings).
 - c. Design Consumption: 1.28 gal./flush.
 - d. Color: White.

2.7 URINALS

A. Urinals, UR-1 and UR-2 (ACC):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Acorn stainless steel or a comparable product by one of the following: (Refer to plans for model number).
 - a. Bradley.
 - b. Or approved equal.
2. Description: Accessible, wall-mounting, back-outlet, vitreous-china fixture and Stainless steel designed for .0125 gal/flush operation.
3. Style: .0125 gal/flush operation.
 - a. Type: Mechanical-free.

- b. Strainer or Trapway: Sealed Locking Cartridge.
- c. Design Consumption: None.
- d. Color: White.
- e. Height: Standard and accessible (see drawings).

2.8 LAVATORIES

A. Lavatories, L-1 (ACC):

1. Basis-of-Design: Subject to compliance with requirements provide American Standard "Lucerne" vitreous china or a comparable product by one of the following: (Refer to plans for model number)
 - a. Kohler Co.
 - b. Or approved equal.
2. Description: Accessible Wall Type Lavatory: drilled for concealed arm assembly; furnished with wall mounted concealed lavatory arm assembly; strainer with 1¼" offset tailpiece, self closing faucet with vandal proof ½ gpm flow control, Chicago no. 1006 ½" loose key angle stop with ½" I.P.S. female inlet x 3/8" compression male outlet and brass wall escutcheon; Fluidmaster No-Burst B1F12 I.A.P.M.O. listed 3/8" x 12" braided stainless steel flexible risers with non-toxic polymer liner, 3/8" compression female inlet, ½" I.P.S. female outlet and hexagon non-ferrous nuts; 1¼" x 1½" cast brass L.A. "P" trap. Assembly shall comply with C.P.C. requirements for accessible fixtures.

2.9 SINKS

A. Commercial Sink, S-1 (ACC):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Just Manufacturing Company or a comparable product by one of the following: (Refer to plans for model number).
 - a. Elkay Manufacturing Co.
2. Description: 18 gauge, Type 304 stainless steel with stainless steel strainer with 1½" tailpieces; faucet vandal proof 1.5 gpm laminar flow control, Chicago angle stop fitting no. 1006 ABCP ½" inlet and outlet to slip 3/8" O.D. tubing and brass wall escutcheons, continuous brass drain and 1½" cast brass L.A. "P" trap. Assembly shall comply with C.P.C. requirements for accessible fixtures.

B. Commercial Sink, S-2:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Just Manufacturing Company or a comparable product by one of the following: (Refer to plans for model number).

- a. Elkay Manufacturing Co.
2. Description: 18 gauge, Type 304 stainless steel with stainless steel strainer with 1½" tailpieces; faucet vandal proof 1.5 gpm laminar flow control, Chicago angle stop fitting no. 1006 ABCP ½" inlet and outlet to slip 3/8" O.D. tubing and brass wall escutcheons, continuous brass drain and 1½" cast brass L.A. "P" trap. Assembly shall comply with C.P.C requirements for accessible fixtures.

2.10 Showers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Commercial Enameling Company or a comparable product. (Refer to plans for model number)
2. Description: Trap-standard- and floor-mounting, enameled, cast-iron fixture with roll-rim with plain back and rim guard on front and sides.
 - a. Size: Refer to Architectural drawings.
 - b. Color: White.
 - c. Drain: Grid with NPS 3 outlet.
 - d. Trap Standard: NPS 3 enameled, cast iron with cleanout and floor flange.

2.11 SERVICE SINKS

A. Service Sinks, SS-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Commercial Enameling Company or a comparable product. (Refer to plans for model number)
2. Description: Trap-standard- and floor-mounting, enameled, cast-iron fixture with roll-rim with plain back and rim guard on front and sides.
 - a. Size: 28 by 28 inches.
 - b. Color: White.
 - c. Drain: Grid with NPS 3 outlet.
 - d. Trap Standard: NPS 3 enameled, cast iron with cleanout and floor flange.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install fixtures level and plumb according to roughing-in drawings.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- K. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- L. Install toilet seats on water closets.
- M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- Q. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- R. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 40 00

SECTION 22 45 00 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following emergency plumbing fixtures:
 - 1. Combination units.

1.2 DEFINITIONS

- A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Cooled Water: Cooled potable water produced by water cooler.
- C. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- D. Tepid: Approximately 85 deg F temperature.
 - 1. Allowable Variation: Plus or minus 5 deg F.

1.3 SUBMITTALS

- A. Product Data: Include flow rates and capacities; furnished specialties; and accessories for each product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities "Americans with Disabilities Act"; about plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.
- E. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- F. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
 - 2. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 COMBINATION UNIT

- A. Combination Unit, Emergency Shower/Eyewash Unit, ESEW-1.
 - 1. Products:
 - a. Haws 8300-8309
 - 2. Piping: Galvanized steel or stainless steel.
 - a. Unit supply: NPS 1-1/4 minimum from top.
 - b. Unit drain: Outlet at side near bottom.
 - c. Shower supply: NPS 1 with flow regulator and stay-open control valve.
 - d. Eye/Face Wash Supply: NPS 1/2 with flow regulator and stay-open control valve.
 - 3. Shower Capacity: Deliver potable water at rate not less than 20 gpm for a at least 15 minutes.
 - a. Control-Valve Actuator: Pull rod.
 - b. Shower Head: 8-inch minimum diameter, plastic.
 - 4. Eye/Face Wash Equipment: With capacity to deliver potable water at rate not less than 3.0 gpm for at least 15 minutes.
 - a. Control-Valve Actuator" Paddle
 - b. Receptor: Stainless steel.

2.3 SOURCE QUALITY CONTROL

- A. Certify performance of plumbed emergency plumbing fixtures by independent testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EMERGENCY PLUMBING FIXTURE INSTALLATION

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components according to manufacturers written instructions.
- B. Fasten fixtures to substrate.
- C. Install shutoff valves in water supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Refer to Division 22 Section "Plumbing, Piping and Valves for general-duty shutoff valves".
 - 1. Exception: Omit shutoff valves on supplies to emergency equipment if prohibited by authorities having jurisdiction.
- D. Install shutoff valve and strainer in steam piping and shutoff valve in condensate return piping.
- E. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Refer to Division 23 Section "Basic Mechanical Materials and Methods " for dielectric fittings.
- F. Install trap and waste to wall on drain outlet of fixture receptors that are indicated to be directly connected to drainage system.
- G. Install indirect waste piping to wall on drain outlet of fixture receptors that are indicated to be indirectly connected to drainage system. Refer to Division 22 Section "Plumbing, Piping and Valves for piping".
- H. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Refer to Division 23 Section "Basic Mechanical Materials and Methods " for escutcheons.
- I. Fill self-contained fixtures with flushing fluid.

3.2 CONNECTIONS

- A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment.

- B. Connect cold- and cooled-water-supply piping to cold- and cooled-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.
- C. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary drainage and vent piping.
- D. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary or storm drainage piping.

3.3 ADJUSTING

- A. Adjust or replace fixture flow regulators for proper flow.
- B. Adjust equipment temperature settings.

END OF SECTION 22 45 00

SECTION 22 47 00 - DRINKING FOUNTAINS AND WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Wall-mounting drinking fountains.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements for fixtures for people with disabilities. 2016 CBC & 2010 ADA standards.
- B. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

- A. Drinking Fountain, DF-1 (ACC):
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Oasis International or a comparable product by one of the following: (Refer to plans for model number).
 - a. Haws Corporation
 - b. Elkay Manufacturing Company
 - b. Acorn Engineering.
 - 2. Description: Wall-mounted drinking fountain.

- a. Material: Stainless steel top and heavy duty galvanized steel frame. Greystone powder coated paint on galvanized steel.
- b. Receptor Shape: Rectangular.
- c. Bottle Filler: Stainless-steel wall plate behind drinking fountain with contactless bottle filler.
- d. Bubblers: Two, contactless, with adjustable stream regulator, located on deck.
- e. Control: Contactless ADA compliant.
- f. Supply: NPS 3/8 with ball, gate, or globe valve.
- g. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.2.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Set freestanding and pedestal drinking fountains on floor.
- C. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view.

3.2 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
- B. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- F. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, traps, and risers, and with soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

END OF SECTION 22 47 00

SECTION 22 66 00 – CHEMICAL-WASTE SYSTEMS FOR LABORATORY FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall piping.
 - 2. Double-containment piping.
 - 3. Field-fabrication containment piping.
 - 4. Piping specialties.
 - 5. Neutralization tanks.
 - 6. Neutralization systems.
 - 7. Manholes.
 - 8. Leak-detection systems.

1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. FPM: Vinylidene fluoride-hexafluoro propylene copolymer rubber.

1.4 PERFORMANCE REQUIREMENTS

- A. Single-Wall Piping Pressure Rating: 10 feet head of water.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. CHPS Submittals:
 - 1. Product Data: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For chemical-waste specialties and neutralization tanks, to include in emergency operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Neutralization-Tank Limestone: Equal to 200 percent of amount required for each tank sump initial charge. Furnish limestone in 50-lb bags.
 - 2. Neutralization-System Limestone and Chemicals: For neutralization system.
 - a. Limestone: Equal to 500 percent of amount required for tank sump initial charge. Furnish limestone in 50-lb bags.
 - b. Chemicals: Equal to 500 percent of neutralizing chemicals required for filling tanks.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 70, "National Electrical Code."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties with sealing plugs in ends or with end protection.
- B. Do not store plastic pipe or fittings in direct sunlight.
- C. Protect pipe, fittings, and seals from dirt and damage.

1.10 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 SINGLE-WALL PIPE AND FITTINGS

- A. PP Drainage Pipe and Fittings: ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions, from PP resin with fire-retardant additive complying with ASTM D 4101; with fusion- and mechanical-joint ends.
 - 1. Exception: Pipe and fittings made from PP resin without fire-retardant additive may be used for underground installation.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. IPEX Inc.
 - b. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
 - c. Sloane, Georg Fischer Inc.
 - d. Town & Country Plastics, Inc.
 - e. Watts Industries (Canada) Inc.
 - f. Zurn Plumbing Products Group; Chemical Drainage Systems.

- B. PVDF Drainage Pipe and Fittings: ASTM F 1673, Schedule 40, pipe and drainage-pattern fittings. Include fittings with fusion joint ends.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
 - b. Watts Industries (Canada) Inc.
 - c. Zurn Plumbing Products Group; Chemical Drainage Systems.
 - d. Sloane, Georg Fischer Inc.

2.2 JOINING MATERIALS

- A. Couplings: Assemblies with combination of clamps, gaskets, sleeves, and threaded or flanged parts; compatible with piping and system liquid; and made by piping manufacturer for joining system piping.
- B. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, gaskets, and threaded or flanged parts; compatible with piping and system liquid; and made for joining different piping materials.
- C. Flanges: Assemblies of companion flanges and gaskets complying with ASME B16.21 and compatible with system liquid, and bolts and nuts.

2.3 PIPING SPECIALTIES

- A. Corrosion-Resistant Traps:
 - 1. Type: P-trap or drum trap.
 - 2. Size: NPS 1-1/2 or NPS 2, as required to match connected piping.
 - 3. High-Silicon Iron: ASTM A 861, with horizontal outlet and hub-and-plain or plain ends to match connecting piping.
 - 4. PP: ASTM D 4101, with mechanical-joint pipe connections.
 - 5. PVDF: ASTM D 3222, with mechanical-joint pipe connections.
 - 6. Glass: ASTM C 1053, with coupling pipe connections.
- B. PP Floor Drains Insert drawing designation:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. IPEX Inc.
 - b. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
 - c. Sloane, George Fischer Inc.
 - d. Town & Country Plastics, Inc.
 - e. Watts Industries (Canada) Inc.
 - 2. Body: With 7- to 9-inch top diameter, with flashing flange and weep holes; and with flashing clamp and trap-primer connection.
 - 3. Outlet: Bottom, to match connecting pipe, with NPS 2, NPS 3, NPS 4, or NPS 6 outlet as indicated.
- C. PP Sink Outlets:
 - 1. Description: NPS 1-1/2, with clamping device, stopper, and 7-inch- high overflow fitting.

2.4 NEUTRALIZATION TANKS

A. Plastic Neutralization Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Striem.
 - b. IPEX Inc.
 - c. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
 - d. Sloane, Georg Fischer Inc.
 - e. Town & Country Plastics, Inc.
 - f. Watts Industries (Canada) Inc.
3. Description: Corrosion-resistant plastic materials; with removable, gastight cover; interior, sidewall, dip-tube inlet; outlet; vent; and threaded or flanged, sidewall pipe connections.
 - a. Material: HDPE or ASTM D 4101, PP.
 - b. Tank Capacity: As indicated on drawings.
 - c. Dip Tube: On outlet pipe instead of inlet pipe.
 - d. Extension: HDPE, PE, or PP.
 - e. Traffic Cover: Light-duty vehicular, steel plate over plastic, bolted.
 - f. Limestone: Chips or lumps, with more than 90 percent calcium carbonate content and 1- to 3-inch diameter.
 - g. Dolomitic Limestone: Chips or lumps, with more than 90 percent combined magnesium carbonate and calcium carbonate content and 1- to 3-inch diameter.

PART 3 - EXECUTION

3.1 EARTHWORK

- #### A.
- Comply with requirements in Section 312000 "Earthwork & Excavations" for excavating, trenching, and backfilling.

3.2 CONCRETE BASES

A. Anchor neutralization tanks to concrete bases.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch centers around full perimeter of base.
2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
6. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 "Cast-in-Place Concrete."
7. Comply with requirements in Division 3 "Cast-in-Place Concrete" for cast-in-place concrete materials and placement.

3.3 PIPING INSTALLATION

A. Chemical-Waste Sewerage Outside the Building:

1. Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground chemical-waste sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
2. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
3. Install cleanouts for changes in direction, unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
4. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
5. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or combination of both.
6. Install drainage piping pitched down in direction of flow, at minimum slope of 2 percent, unless otherwise indicated.
7. Install drainage piping with 36-inch minimum cover.
8. Install PVC drainage piping according to ASTM D 2321 and ASTM F 1668.
9. Install PP drainage piping according to ASTM D 2321 and ASTM F 1668.
10. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

B. Chemical-Waste Piping Inside the Building:

1. Install piping next to equipment, accessories, and specialties to allow service and maintenance.
2. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
3. Flanges may be used on aboveground piping unless otherwise indicated.
4. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
5. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
6. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
7. Install piping at indicated slopes.
8. Install piping free of sags and bends.
9. Install fittings for changes in direction and branch connections.
10. Verify final equipment locations for roughing-in.
11. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 "Sleeves and Sleeve Seals for Plumbing Piping."
12. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 "Sleeves and Sleeve Seals for Plumbing Piping."
13. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 "Escutcheons for Plumbing Piping."

3.4 PIPING SPECIALTY INSTALLATION

- A. Embed floor drains in 4-inch minimum depth of concrete around bottom and sides. Comply with requirements in Division 3 "Cast-in-Place Concrete" for concrete.
- B. Fasten grates to drains if indicated.
- C. Set floor drains with tops flush with pavement surface.
- D. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use fittings of same material as sewer pipe at branches for cleanouts and riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in pipe.
 - 1. Set cleanout bodies in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade. Set cleanout plugs in concrete pavement with tops flush with pavement surface. Comply with requirements in Division 3 "Cast-in-Place Concrete" for formwork, reinforcement, and concrete requirements.
- E. Install backwater valves in horizontal position. Include riser to cleanout at grade.

3.5 JOINT CONSTRUCTION

- A. Chemical-Waste Sewerage Outside the Building:
 - 1. Plastic-Piping, Electrofusion Joints: Make polyolefin drainage-piping joints according to ASTM F 1290.
 - 2. Join dissimilar pipe materials with adapters compatible with pipe materials being joined.
- B. Chemical-Waste Piping Inside the Building:
 - 1. Plastic-Piping Electrofusion Joints: Make polyolefin drainage-piping joints according to ASTM F 1290.
 - 2. Dissimilar-Material Piping Joints: Make joints using adapters compatible with both system materials.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Pipe sizes in this article refer to aboveground, single-wall piping.
- B. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- C. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
 - 1. Vertical Piping: MSS Type 8 or MSS Type 42, riser clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.

- D. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for installation of supports.
- E. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- F. Support vertical piping and tubing at base and at each floor.
- G. Rod diameter may be reduced 1 size for double-rod hangers, to minimum of 3/8 inch.
- H. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 2: 33 inches with 3/8-inch rod.
 - 2. NPS 2-1/2 and NPS 3: 42 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 4. NPS 6: 48 inches with 3/4-inch rod.
 - 5. NPS 8: 48 inches with 7/8-inch rod.
- I. Install supports for vertical PP piping every 72 inches.
- J. Install vinyl-coated hangers for PVDF piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. All Sizes: Install continuous support for piping with liquid waste at temperatures above 140 deg F.
 - 2. NPS 1/2 and Smaller: 30 inches with 3/8-inch rod.
 - 3. NPS 3/4 to NPS 1-1/2: 36 inches with 3/8-inch rod.
 - 4. NPS 2: 36 inches with 3/8-inch rod.
 - 5. NPS 2-1/2 and NPS 3: 42 inches with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 - 7. NPS 6: 48 inches with 3/4-inch rod.
- K. Install supports for vertical PVDF piping NPS 1-1/2 every 48 inches and NPS 2 and larger every 72 inches.
- L. Support piping and tubing not listed above according to MSS SP-69.

3.7 NEUTRALIZATION TANK INSTALLATION

- A. Install exterior neutralization tank, complete with appurtenances indicated.
 - 1. Set tops of tank covers flush with finished surface where covers occur in pavements. Set covers 3 inches above finished surface elsewhere unless otherwise indicated.
 - 2. Include initial fill of limestone for neutralization tanks.

TANK CAPACITY (GAL)	AMOUNT OF LIMESTONE REQUIRED
5	50 lb.
15	100 lb.
30	200 lb.
55	500 lb.
100	1,000 lb.
150	1,750 lb.
200	2,500 lb.
275	3,200 lb.
350	4,000 lb.
500	5,000 lb.
1200	11,000 lb.
1500	15,000 lb.
2000	16,000 lb.

- B. Install interior neutralization tanks on smooth and level concrete base. Include full initial charge of limestone.

3.8 CONCRETE PLACEMENT

- A. Comply with requirements in Division 3 "Cast-in-Place Concrete" for concrete supports.
- B. Place cast-in-place concrete according to ACI 318/318R.

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make connections to existing piping so finished Work complies as nearly as practical with requirements specified for new Work.
- C. Use commercially manufactured wye fittings for sewerage piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
- D. Protect existing piping to prevent concrete or debris from entering while making connections. Remove debris or other extraneous material that may accumulate.
- E. Install piping adjacent to equipment to allow service and maintenance.

3.10 LABELING AND IDENTIFICATION

- A. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for labeling of equipment and piping.
 - 1. Use warning tape or detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.11 FIELD QUALITY CONTROL

- A. Inspect interior of sewerage piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place and again at completion of Project.
 - 1. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between inspection points.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Hydrostatic Tests for Drainage Piping:
 - 1) Close openings in system and fill with water.
 - 2) Purge air and refill with water.
 - 3) Disconnect water supply.
 - 4) Test and inspect joints for leaks.
 - e. Air Tests for Drainage Piping: Comply with UNI-B-6.
 - 2. Leaks and loss in test pressure constitute defects that must be repaired.
 - 3. Submit separate reports for each test.
- B. Replace leaking sewerage piping using new materials, and repeat testing until leakage is within allowances specified.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- E. Tests and Inspections:
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect assembled neutralization systems and their installation, including piping and electrical connections, and to assist in testing.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Chemical-waste piping will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

3.12 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service for neutralization systems.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Neutralization Systems:

- a. Verify that neutralization system is installed and connected according to the Contract Documents.
- b. Verify that electrical wiring installation complies with manufacturer's submittal.
- c. Install neutralizing solutions and limestone.
- d. Energize circuits.
- e. Start and run systems through complete sequence of operations.
- f. Adjust operating controls.

3.13 ADJUSTING

- A. Adjust neutralization-system set points.

3.14 CLEANING

- A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:
 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Clean piping by flushing with potable water.

3.15 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain neutralization systems.

3.16 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below unless otherwise indicated.
- B. Single-Wall, Chemical-Waste Sewerage Piping: Use any of the following piping materials for each size range:
 1. NPS 1-1/2 to NPS 4: PP drainage pipe and fittings and electrofusion joints.
 2. NPS 1-1/2 to NPS 4: PVDF drainage pipe and fittings and electrofusion joints.
 3. NPS 6: PP drainage pipe and fittings and electrofusion joints.
 4. NPS 6: PVDF drainage pipe and fittings and electrofusion joints.
 5. NPS 8 to NPS 12: PP drainage pipe and fittings and electrofusion joints.
 6. NPS 8 to NPS 12: PVDF drainage pipe and fittings and electrofusion joints.
- C. Aboveground Chemical-Waste Piping: Use any of the following piping materials for each size range:
 1. NPS 1-1/2 to NPS 6: PP drainage piping and electrofusion, mechanical joints.
 2. NPS 1-1/2 to NPS 6: PVDF drainage piping and electrofusion joints.
- D. Under Slab-on-Grade, Indoor, Chemical-Waste Piping: Use any of the following piping materials for each size range:
 1. NPS 1-1/2 to NPS 6: PP drainage piping and electrofusion joints.
 2. NPS 1-1/2 to NPS 6: PVDF drainage piping and electrofusion joints.

END OF SECTION 22 66 00

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Equipment installation requirements common to equipment sections.
 - 3. Concrete bases.
 - 4. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss,

expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- M. Verify final equipment locations for roughing-in.
- N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base as detailed.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. See Detail 13 on S0.3.
2. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
3. Install anchor bolts to elevations required for proper attachment to supported equipment.
4. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

END OF SECTION 23 05 00

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 13

SECTION 23 05 16 - PIPE EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following pipe expansion joints and expansion compensation devices for mechanical piping systems:
 - 1. Pipe bends and loops.
 - 2. Alignment guides and anchors.

1.2 DEFINITIONS

- A. BR: Butyl rubber.
- B. Buna-N: Nitrile rubber.
- C. CR: Chlorosulfonated polyethylene synthetic rubber.
- D. CSM: Chlorosulfonyl-polyethylene rubber.
- E. EPDM: Ethylene-propylene-diene terpolymer rubber.
- F. NR: Natural rubber.
- G. PTFE: Polytetrafluoroethylene plastic.

1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Capability: Products shall absorb 200 percent of maximum axial movement between anchors.

1.4 SUBMITTALS

- A. Product Data: For each type of pipe expansion joint and alignment guide indicated.
- B. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.
- C. Welding certificates.
- D. Operation and Maintenance Data: For pipe expansion joints to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."
 - 2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

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 EXPANSION JOINTS

- A. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.
 - 1. Manufacturers:
 - a. Metraflex, Inc.
 - b. ADSCO.
 - c. Flexonics.
 - 2. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder- joint end connections.
 - a. NPS 2 and Smaller: Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
 - b. NPS 2-1/2 to NPS 4: Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.
 - 3. Flexible-Hose Expansion Joints for Steel Piping: Carbon-steel fittings with threaded end connections for NPS 2 and smaller and flanged end connections for NPS 2-1/2 and larger.
 - a. NPS 2 and Smaller: Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
 - b. NPS 2-1/2 to NPS 6: Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.

2.3 ALIGNMENT GUIDES

- A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.

1. Manufacturers:
 - a. Metraflex, Inc.
 - b. ADSCO.
 - c. Flexonics.

2.4 MATERIALS FOR ANCHORS

- A. Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
 1. Stud: Threaded, zinc-coated carbon steel.
 2. Expansion Plug: Zinc-coated steel.
 3. Washer and Nut: Zinc-coated steel.
- E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.
 1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 3. Washer and Nut: Zinc-coated steel.
- F. Concrete: Portland cement mix, 3000 psi minimum. Refer to Division 3 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.
- G. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

- A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
- B. Install expansion joints of sizes matching size of piping in which they are installed.
- C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

3.2 PIPE BEND AND LOOP INSTALLATION

- A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Attach pipe bends and loops to anchors.
 - 1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.3 SWING CONNECTIONS

- A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.4 ALIGNMENT-GUIDE INSTALLATION

- A. Install guides on piping adjoining pipe expansion joints and bends and loops.
- B. Attach guides to pipe and secure to building structure.

3.5 ANCHOR INSTALLATION

- A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
- D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints or compensators are indicated.
- E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

END OF SECTION 23 05 16

SECTION 23 05 19 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following meters and gages for mechanical systems:
 - 1. Thermometers.
 - 2. Gages.
 - 3. Test plugs.

1.02 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.
- B. Shop Drawings: Schedule for thermometers, gages, and flowmeters indicating manufacturer's number, scale range, and location for each.
- C. Product Certificates: For each type of thermometer, gage, and flowmeter, signed by product manufacturer.
- D. Operation and Maintenance Data: For flowmeters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers:
 - 1. U.S. Gauge.

2. Terice, H. O. Co.
 3. Weiss Instruments, Inc.
- B. Case: Brass, 9 inches long.
- C. Tube: Red reading, organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Glass.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length longer than pipe diameters in pipe tee.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.03 THERMOWELLS

- A. Manufacturers: Same as manufacturer of thermometer being used.
- B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.04 PRESSURE GAGES

- A. Manufacturers:
1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 2. U.S. Gauge.
 3. Terice, H. O. Co.
- B. Direct-Mounting, Dial-Type Pressure Gauges: Indicating-dial type complying with ASME B40.100.
1. Case: Dry type, drawn steel or cast aluminum, 6-inch diameter.
 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 6. Pointer: Red metal.
 7. Window: Glass.
 8. Ring: Metal.
 9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
 10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 11. Range for Fluids under Pressure: Two times operating pressure.
- C. Pressure-Gage Fittings:
1. Valves: NPS 1/4 brass or stainless-steel needle type.

2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.05 TEST PLUGS

- A. Manufacturers:
 1. Peterson Equipment Co., Inc.
 2. Sisco Manufacturing Co.
- B. Description: Corrosion-resistant brass body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- C. Minimum Pressure and Temperature Rating: 1,000 psig at 200 deg F.
- D. Core Inserts: One or two self-sealing rubber valves.
 1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
 2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.
- E. Test Kit: Furnish two test kit(s) containing one pressure gage and adaptor, two thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
 1. Pressure Gage: Small bourdon-tube insertion type with 2 ½ inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
 2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
 3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
 4. Carrying case shall have formed instrument padding.

PART 3 - EXECUTION

3.01 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the following locations:
 1. Inlet and outlet of each hydronic coil in air-handling unit.
- B. Provide the following temperature ranges for thermometers:
 1. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
 2. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.

3.02 GAGE APPLICATIONS

- A. Install dry -case-type pressure gages at chilled- and hot-water inlets and outlets of air handling unit coils.

3.03 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.

- B. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.
- C. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).
- D. Install test plugs in tees in piping.

3.04 CONNECTIONS

- A. Install gages adjacent to machines and equipment to allow service and maintenance for gages, machines, and equipment.

3.05 ADJUSTING

- A. Adjust faces of gages to proper angle for best visibility.

END OF SECTION 23 05 19

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following general-duty valves:
 - 1. Copper-alloy ball valves.
 - 2. Ferrous-alloy butterfly valves.
- B. Related Sections include the following:
 - 1. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and charts.
 - 2. Division 23 Section "Sequence of Operations for HVAC Controls" for control valves and actuators.
 - 3. Division 23 piping Sections for specialty valves applicable to those Sections only.

1.02 DEFINITIONS

- A. The following are standard abbreviations for valves:
 - 1. CWP: Cold working pressure.
 - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 3. NBR: Acrylonitrile-butadiene rubber.
 - 4. PTFE: Polytetrafluoroethylene plastic.
 - 5. SWP: Steam working pressure.
 - 6. TFE: Tetrafluoroethylene plastic.

1.03 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.04 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.9 for building services piping valves.
 - 1. Exceptions: Domestic hot- and cold-water piping valves unless referenced.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, grooves, and weld ends.
 3. Set angle, gate, and globe valves closed to prevent rattling.
 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 5. Set butterfly valves closed or slightly open.
 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.
- C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- F. Valve Actuators:
1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
 2. Gear Drive: For quarter-turn valves NPS 8 and larger.
 3. Handwheel: For valves other than quarter-turn types.
 4. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
 5. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
- G. Extended Valve Stems: On insulated valves.

- H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
 - I. Valve Grooved Ends: AWWA C606.
 - 1. Solder Joint: With sockets according to ASME B16.18.
 - a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
 - 2. Threaded: With threads according to ASME B1.20.1.
 - J. Valve Bypass and Drain Connections: MSS SP-45.
- 2.03 COPPER-ALLOY BALL VALVES (2" and smaller)
- A. Manufacturers:
 - 1. Two-Piece, Copper-Alloy Ball Valves:
 - a. Conbraco Industries, Inc.; Apollo Div. # B 6080
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Nibco T-585-70.
 - e. Kitz 68.
 - B. Copper-Alloy Ball Valves, General: MSS SP-110.
 - C. Two-Piece, Copper-Alloy Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 400psig minimum CWP rating at 150° F and blowout-proof stem.
 - D. Steel handle with ¼ turn vinyl handle, and integral handle stops.
- 2.04 FERROUS-ALLOY BUTTERFLY VALVES
- A. Manufacturers:
 - 1. Single-flange, Ferrous-Alloy Butterfly Valves:
 - a. Nibco LD 2000.
 - b. Milwaukee ML-233-E.
 - B. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.
 - C. Single-Flange, 150-psig at 250° F CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer-lug type with one-piece stem. Cast or ductile iron body; Bronze, aluminum bronze or stainless steel disc, EPDM seat.
 - D. Valve stems shall be type 416 stainless steel.
 - E. Face to face, end to end dimensions shall comply with ANSI B16.10.

- F. Operator shall be 10 position lever lock for 2 through 5 inches and totally enclosed and sealed worm gear actuators with 4 arm or wheel handle for 6 inch sizes and larger.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly.
 - 2. Throttling Service: ball, butterfly valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Chilled-Water, Heating Hot Water: Use the following types of valves:
 - 1. Ball Valves, NPS 2 and Smaller: Two-piece, 400-psig CWP rating, copper alloy.
 - 2. Butterfly Valves, NPS 2-1/2 and Larger: Single-Flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
- D. Select valves, except wafer and flangeless types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water, heating hot water.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
 - 7. For Grooved-End, Copper Tubing and Steel Piping: Valve ends may be grooved.

3.03 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.

3.04 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Common Work Results for HVAC" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.05 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 23 05 23

SECTION 23 05 33 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. See Division 23 Section "Pipe Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
- C. See Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
- D. See Division 23 Section "Metal Ducts" for duct hangers and supports.

1.02 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.03 REQUIREMENTS

- A. Supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water shall be in accordance with approved drawings. Where conditions exist that are not detailed, installation shall comply with OSHPD Pre-Approved anchorage: Mason OPM #0043-13, Vibrex OPM #0203-13 or approved equivalent.
- B. Equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components shall be in accordance with approved drawings. Where conditions exist that are not detailed, installation shall comply with OSHPD Pre-Approved anchorage: Mason OPM #0043-13, Vibrex OPM #0203-13 or approved equivalent.
- C. Seismic-restraint hangers and supports for piping and equipment shall be in accordance with approved drawings. Where conditions exist that are not detailed, installation shall comply with OSHPD Pre-Approved anchorage: Mason OPM #0043-13, Vibrex OPM #0203-13 or approved equivalent.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.

2. Thermal-hanger shield inserts.
 3. Powder-actuated fastener systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers. Include Product Data for components.
 2. Metal framing systems. Include Product Data for components.
 3. Equipment supports.
- C. Welding certificates.

1.05 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
1. Mason Industries.
 2. MW Sausse.
 3. B-Line Systems, Inc.; a division of Cooper Industries.
 4. Elcen.
 - 5.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.03 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.04 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Tolco Inc.
 - 3. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.05 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. Grinnell.
 - 3. Elcen.
 - 4. Pipe Shields, Inc.
- C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.06 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Refer to post-installed concrete anchors indicated on Structural plans and specifications. ICC ESR is required for all fasteners, system/components.

2.07 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.08 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 - 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 - 6. C-Clamps (MSS Type 23): For structural shapes.
 - 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 - 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.02 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

- c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.06 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 23 05 33

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Restrained spring isolators.
 - 2. Restrained vibration isolation roof-curb.
 - 3. Seismic snubbers.
 - 4. Spring hangers with vertical-limit stops.
 - 5. Restraining cables.

1.3 DEFINITIONS

- A. A_v : Effective peak velocity related acceleration coefficient.
- B. OSHPD: Office of Statewide Health Planning & Development for the State of California. OSHPD assigns a unique anchorage preapproval "OPM" number to each seismic restraint it tests. The number describes a specific device applied as tested.

1.4 PERFORMANCE REQUIREMENTS

- A. A_v : According to seismic code of Governing Jurisdiction.
- B. Component Seismic Coefficient: Refer to equipment schedule for value for each piece of equipment.
- C. Performance Criteria Factor: Refer to equipment schedule for value for each piece of equipment.
- D. Attachment Amplification Factor: Refer to equipment schedule for value for each piece of equipment.

1.5 SUBMITTALS

- A. Product Data: Include load deflection curves for each vibration isolation device.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following:
 - 1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 - 4. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
 - 5. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y, and z planes.
- C. Welding certificates.
- D. Manufacturer Seismic Qualification Certification: Submit certification that all specified equipment will withstand seismic forces identified in "Performance Requirements" Article above. Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 QUALITY ASSURANCE

- A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to OSHPD and shall bear anchorage preapproval "OPM" number, from OSHPD or another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer. Testing and calculations must include both shear and tensile loads and 1 test or analysis at 45 degrees to the weakest mode.
- B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

1.7 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 VIBRATION ISOLATORS

- A. Manufacturers:
 - 1. MicroMetl
 - 2. Mason Industries, Inc.
 - 3. M. W. Sausse'.
- B. Restrained Spring Isolators (RSI): Freestanding, steel, open-spring isolators with seismic restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- C. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.3 RESTRAINED VIBRATION ISOLATION ROOF-CURB (RSC)- 20 TONS AND GREATER

- A. Manufacturers:
 1. MicroMetl
 2. Mason Industries, Inc.
 3. M. W. Sausse'.
- B. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand 125-mph wind impinging laterally against side of equipment.
- C. Lower Support Assembly: Sheet-metal "Z" section containing adjustable and removable steel springs that support upper floating frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist wind and seismic forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
- D. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
 1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
 - a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 2. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
 - a. Material: Bridge-bearing neoprene, complying with AASHTO M 251.
- E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.

- F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

2.4 VIBRATION ISOLATION SEISMIC CURB (ISC)

- A. Manufacturers:
 - 1. MicroMetl
 - 2. Mason Industries, Inc.
 - 3. M. W. Sausse'.
- B. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand 125-mph wind impinging laterally against side of equipment. See M0.6 for additional information.
- C. Lower Support Assembly: Sheet-metal "Z" section containing adjustable and removable steel springs that support upper floating frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist wind and seismic forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
- D. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
 - 1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
 - a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 2. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
 - a. Material: Bridge-bearing neoprene, complying with AASHTO M 251.
- E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

2.5 SEISMIC-RESTRAINT DEVICES (PIPING AND SUSPENDED EQUIPMENT)

- A. Manufacturers:
 - 1. Mason Industries, Inc.
 - 2. TOLCO Incorporated.
 - 3. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
 - 4. M. W. Sausse'.
 - 5. B- Line Systems.
- B. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.
- C. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5.
- D. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.
- E. Anchor Bolts: Seismic-rated, drill-in, and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.

2.6 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be electrogalvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances, and other conditions affecting performance.

- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install roof curbs, equipment supports, and roof penetrations as specified in Division 07.
- B. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.
- C. Install seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
- D. Install restraining cables at each trapeze and individual pipe hanger. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
- E. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.
- F. Install resilient bolt isolation washers on equipment anchor bolts.

3.3 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. Isolator seismic-restraint clearance.
 - 2. Isolator deflection.
 - 3. Snubber minimum clearances.

3.4 ADJUSTING

- A. Adjust isolators after piping systems have been filled and equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.
- D. Adjust active height of spring isolators.
- E. Adjust snubbers according to manufacturer's written recommendations.

- F. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
- G. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

3.5 CLEANING

- A. After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt, and debris.

3.6 VIBRATION ISOLATOR AND SEISMIC-RESTRAINT SCHEDULE

- A. Supported Equipment:
 - 1. Package Rooftop AC units:
 - a. Isolation Type:
 - b. Deflection: 2"
- B. Suspended Equipment:
 - 1. Inline Fans:
 - a. Isolator Type: Spring
 - b. Minimum Deflection: 1".

END OF SECTION 23 05 48

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.

1.2 SUBMITTAL

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: Black.
 - 3. Background Color: White.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow or Orange.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.

- C. Background Color: Blue.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Refrigerant Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

3.4 DUCT LABEL INSTALLATION

- A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
 1. Blue: For cold-air supply ducts.
 2. Yellow: For hot-air supply ducts.
 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - 2. HVAC equipment quantitative-performance settings.
 - 3. Verifying that automatic control devices are functioning properly.
 - 4. Reporting results of activities and procedures specified in this Section.

1.2 SUBMITTALS

- A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- B. Warranties specified in this Section.

1.3 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC.
- B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."

1.4 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.5 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- D. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- E. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- F. Examine system and equipment test reports.

- G. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- I. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine equipment for installation and for properly operating safety interlocks and controls.
- M. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance, smoke, and fire dampers are open.
 - 5. Isolating and balancing valves are open and control valves are operational.
 - 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling unit components.
- K. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

3.6 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

A. Refrigerant Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.9 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.10 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.

- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.11 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
 - 2. Air Outlets and Inlets: 0 to minus 10 percent.

3.12 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 - 1. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports varies from indicated values.
14. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Balancing stations.
4. Position of balancing devices.

3.13 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 23 05 93

SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply, return, and outdoor air.
- B. Related Sections:
 - 1. Section 230719 "HVAC Piping Insulation."
 - 2. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Vimasco Corporation.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Vimasco Corporation.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 4. Service Temperature Range: 0 to plus 180 deg F.
 5. Color: White.

2.5 SEALANTS

- A. FSK Flashing Sealants:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: Aluminum.
 6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Vimasco Corporation.

2.8 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Alpha Associates, Inc.

2.9 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Ideal Tape Co., Inc.; an American Biltrite company.
 - c. Venture Tape.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.10 SECUREMENTS

A. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Midwest Fasteners, Inc.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. C & F Wire.

2.11 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.

- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Section 078400 "Firestopping".
- E. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078400 "Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 - 3. Install pins and washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.

- f. Cut excess portion of pins extending beyond washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
- 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
- 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
- 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
- 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.7 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply and return.
 - 2. Supply and return.
- B. Items Not Insulated:
 - 1. Fibrous-glass ducts.

2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.8 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, supply-air, return air, and outside-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 3 inches thick and 1.5-lb/cu. ft. nominal density, 8.0 installed R-value.
2. Mineral-Fiber Blanket: 3 inches thick and 1.5-lb/cu. Ft, 8.0 installed R-value. nominal density.

3.9 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Supply-air and return-air duct insulation shall be lined as described in 233113 "Metal Ducts":

END OF SECTION 23 07 13

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
 - 1. Refrigerant suction and hot-gas piping, indoors and outdoors.
- B. Related Sections:
 - 1. Section 230713 "Duct Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at pipe expansion joints for each type of insulation.
 - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 4. Detail removable insulation at piping specialties.
 - 5. Detail application of field-applied jackets.
 - 6. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- D. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. K-Flex USA.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Foster Brand; H. B. Fuller Construction Products.
 - b. Vimasco Corporation.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 5. Color: White.
- 2.4 FIELD-APPLIED JACKETS
- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Metal Jacket:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. ITW Insulation Systems; Illinois Tool Works, Inc.
 - c. RPR Products, Inc.
 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Finish and thickness are indicated in field-applied jacket schedules.
 - b. Factory-Fabricated Fitting Covers:

- 1) Same material, finish, and thickness as jacket.
- 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
- 3) Tee covers.
- 4) Flange and union covers.
- 5) End caps.
- 6) Beveled collars.
- 7) Valve covers.
- 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.5 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ITW Insulation Systems; Illinois Tool Works, Inc.
 - b. RPR Products, Inc.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

PART 3 - EXECUTION

3.1 EXAMINATION

- #### A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- #### A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- J. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- K. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- L. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.

3. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078400 "Firestopping".
 2. Pipe: Install insulation continuously through floor penetrations.
 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078400 "Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Insulate strainers so strainer basket flange or plug can be easily removed and

- replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
- 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION
- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Do not field paint aluminum jackets.

3.9 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping:
 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.
- B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.

3.11 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping:
 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 2 inches thick.
- B. Refrigerant Suction and Hot-Gas Flexible Tubing:
 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 2 inches thick.

3.12 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping:
 1. Aluminum, Stucco Embossed: 0.024 inch thick.

END OF SECTION 23 07 19

SECTION 23 09 00 – BUILDING MANAGEMENT AND CONTROL SYSTEMS

PART 1 – GENERAL

1.1 WORK INCLUDED:

- A. The Building Automation System (BAS) manufacturer shall furnish and install a fully integrated building automation system as an extension to the existing District Wide Siemens Apogee System, to match the district's standard incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems as herein specified. The installation of the control system shall be performed under the direct supervision of the controls manufacturer with the shop drawings, bill of materials, component designation or identification number and sequence of operation all bearing the name of the manufacturer.
- B. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed specially for this project. All systems and components shall have been thoroughly tested and proven in actual use for at least two years.
- C. BAS manufacturer shall be responsible for all BAS and Temperature Control wiring for a complete and operable system. All wiring shall be done in accordance with all local/national codes and Division 16. All exposed low voltage control wiring throughout the building shall be run in conduit. All low voltage electrical wiring above ceiling may be run in plenum cable. Room sensor cables concealed behind walls shall be run in conduit, with room sensor conduit extending above wall into accessible ceiling. Cable is to be supported off building structure. Support off ductwork, pipe racks, etc. is not acceptable.

1.2 WORK BY OTHER DISCIPLINES

- A. Mechanical Contractor provides:
 - 1. All wells, inline devices, and openings for water monitoring devices and flow switches.
 - 2. Installation of control valves.
 - 3. All package unit control panels.
 - 4. Furnish & install all smoke fire/smoke, outdoor air, return air, exhaust air, and mixing dampers; with adjacent access doors.
- B. Electrical Contractor provides:
 - 1. 120 volt and 20 amp circuits and circuit breakers from normal and/or emergency power panel to direct digital control system panels.
 - 2. Wiring of all power feeds through all disconnects and starters to electrical motor.
 - 3. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished by BAS manufacturer
 - 4. Conduit w/ pull strings between buildings for network communication
 - 5. Other conduits as shown on the plans.
 - 6. Duct smoke detectors & their wiring

1.3 GENERAL PRODUCT DESCRIPTION

- A. The building automation system shall be an extension to the existing Siemens Apogee System.
 - B. Provide Siemens standard, native protocol for the communications system. The system shall have the capability to interface with standard protocols where specified on the mechanical plans.
 - C. System shall be capable of high speed Ethernet communication using TCP/IP protocol.
 - D. The Operator Workstation is existing, and all new work will communicate with this existing workstation. Additional workstations are not to be installed.
 - 1. Provide system graphics for each controlled device and/or integrated systems as required by the owner. Origin of information shall be transparent to the operator and shall be controlled, displayed, trended, etc. as if the points were hardwired to the BAS.
 - E. The building automation system shall consist of the following:
 - 1. Stand-alone Primary DDC Controllers (PXC Product Line)
 - 2. Stand-alone Application Specific Controllers (TECs)
 - 3. Point Modules
 - F. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC Controllers, Application Specific Controllers and operator devices.
 - G. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC Controller shall operate independently by performing its own specified control, alarm management, operator I/O, and data collection. The failure of any single component or network connection shall not interrupt the execution of any control strategy, reporting, alarming and trending function, or any function at any operator interface device.
 - H. DDC Controllers shall be able to access any data from, or send control commands and alarm reports directly to, any other DDC Controller or combination of controllers on the network without dependence upon a central or intermediate processing device.
 - I. DDC Controllers shall be able to assign password access and control priorities to each point individually. The logon password (at any PC workstation or portable operator terminal) shall enable the operator to monitor, adjust or control only the points that the operator is authorized for. All other points shall not be displayed at the PC workstation or portable terminal. (e.g., all base building and all tenant points shall be accessible to any base building operators, but only certain base building and tenant points shall be accessible to tenant building operators). Passwords and priority levels for every point shall be fully programmable and adjustable.
- 1.4 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION
- A. Hydronic Piping:
 - 1. Control Valves
 - 2. Temperature Sensor Wells
 - 3. Water Flow Meters where specified on the mechanical plans

1.5 APPROVED CONTROL SYSTEM CONTRACTORS AND MANUFACTURERS

- A. The contractor shall use the Siemens Apogee System. No other manufacturer shall be accepted. This item is being sole sourced per Public Contract Code Section 3400, subdivision (b) (2) to match equipment in use at the project either completed or in the course of completion.
- B. Siemens Industry, Inc. – (714) 227-5140 – Doug Pittard
- C. No substitutions shall be accepted. No known equal.

1.6 QUALITY ASSURANCE

- A. The BAS system shall be designed and installed, commissioned and serviced by manufacturer trained personnel. BAS contractor shall have an in-place support facility within 100 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment. The BAS contractor shall provide an experienced project manager for this work, responsible for supervision of the design, installation, start up and commissioning of the BAS. The Bidder shall be regularly engaged in the installation and maintenance of BAS systems and shall have a minimum of ten (10) years of demonstrated technical expertise and experience in the installation and maintenance of BAS systems similar in size and complexity to this project.
- B. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.
- C. BAS shall comply with UL 916 PAZX and 864 UDTZ, ULC, and other subsystem listings as applicable, and herein specified, and be so listed at the time of bid.
- D. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.
- E. This system shall have a documented history of compatibility by design for a minimum of 15 years. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability to upgrade existing field panels to current level of technology, and extend new field panels on a previously installed network. Any existing field panel microprocessor must be able to be connected and directly communicate with new field panels without bridges, routers or protocol converters with the exception for Apogee Ethernet Microprocessors.

1.7 SUBMITTALS

- A. Product Submittal Requirements. Provide electronic copies of shop drawings and other submittals on hardware and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. When manufacturer's data sheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Provide submittal as a single, complete set. Valves and long lead time items may be submitted separately for approval to meet construction schedules.
- B. Submittal data shall consist of the following:

1. Direct Digital Control System Hardware:
 - a. Complete bill of materials indicating quantity, manufacturer, and model number of equipment to be used.
 - b. Manufacturer's description and technical data, such as product specification sheets:
 - c. Wiring diagrams and layouts for each control panel. Show all termination numbers.
 2. Controlled Systems:
 - a. Riser diagrams showing control network layout, communication protocol, wire types, and DDC Controller locations. Zone riser diagrams showing all zone controllers, network wiring, and power wiring.
 - b. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
 - c. Schematic wiring diagram of each controlled system. Label control elements and terminals.
 - d. Bill of Material
 - e. Complete description of control system operation including sequences of operation. Sequence of operation shall be provided by the Mechanical Engineer, and modified as necessary by the BAS contractor to match the equipment installed and district standards.
 - f. Physical point list for each system controller including both inputs and outputs (I/O), point numbers, and controlled device associated with each I/O point.
 3. Contractor shall submit documentation in the following phased delivery schedule:
 - a. Valve schedules and long lead items (if necessary to meet construction schedule)
 - b. Control Submittal:
 - 1) System Riser Diagrams
 - 2) Sequence of Operations
 - 3) Mechanical Control Schematics
 - 4) Electrical Wiring Diagrams
 - 5) Control Panel Layouts
 - 6) Product Specification Sheets
 - c. Record drawings
 - C. Project Record Documents: Submit electronic copy of record documents upon completion of installation. Submittal shall consist of:
 1. Project Record Drawings. As-built versions of the submittal package.
- 1.8 WARRANTY
- A. Provide all services, materials and equipment necessary for the successful operation of the entire BAS system for a period of one year after beneficial use.

- B. The adjustment, required testing, and repair of the system includes all computer equipment, transmission equipment and all sensors and control devices.
- C. If requested by owner, the service modem can be installed. The on-line support services shall allow the local BAS subcontractor to dial out over telephone lines to monitor and control the facility's building automation system. This remote connection to the facility shall be within 2 hours of the time that the problem is reported. This coverage shall be extended to include normal business hours, after business hours, weekends and holidays. Owner shall provide phone lines for this service.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. The contractor shall use the Siemens Apogee System. No other manufacture shall be accepted. This item is being sole sourced per Public Contract Code Section 3400, subdivision (b) (2) to match equipment in use at the project either completed or in the course of completion.
- B. Siemens Industry, Inc. 714.227.5140 – Doug Pittard
- C. No substitutions shall be accepted. No known equal.

2.2 COMMUNICATION

- A. The design of the BAS shall support networking of operator workstations and Primary DDC Controllers. The network architecture shall consist of two levels, an Ethernet based primary network for all operator workstations, servers, and primary DDC controllers, and a secondary Floor Level Networks (FLN) for terminal equipment application specific controllers.
- B. Primary Network Communication
 - 1. The Primary Ethernet Network shall be installed and maintained by the owner. The BAS shall reside on the campus network. One Ethernet connection point shall be brought to each building by the owner, including the wiring and all necessary hardware. The BAS shall provide any additional wiring and hardware if multiple connections to the Ethernet are required. The BAS contractor is to coordinate with the owner for IP Addressing and gateway information.
 - 2. Any controller residing on the primary network shall connect to Ethernet network without the use of a PC or a gateway with a hard drive.
 - 3. Any PC on the Primary Network shall have transparent communication with controllers on the building level networks connected via Ethernet.
 - 4. Any break in Ethernet communication from the PC to the controllers on the Primary Network shall result in a notification at the PC.
 - 5. The standard client and server workstations on the Primary Network shall reside on industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3.
 - 6. System software applications will run as a service to allow communication with Primary Network Controllers without the need for user log in. Closing the application or logging off shall not prevent the processing of alarms, network status, panel failures, and trend information.

C. Primary Network – DDC Controller Panel to Panel Communication:

1. All Primary DDC Controllers shall directly reside on the primary Ethernet network so that communications may be executed directly between Primary DDC Controllers, directly between server and Primary DDC Controllers on a peer-to-peer basis.
2. Systems that operate via polled response or other types of protocols that rely on a central processor, file server, or similar device to manage panel-to-panel or device-to-device communications shall not be acceptable, except where integration is required.
3. All operator interfaces shall have the ability to access all point status and application report data or execute control functions for any and all other devices. Access to data shall be based upon logical identification of building equipment. No hardware or software limits shall be imposed on the number of devices with global access to the network data.
4. The primary network shall use TCP/IP over Ethernet. All devices must:
 - a. Auto-sense 10/100 Mbps networks.
 - b. Receive an IP Address from a Dynamic Host Configuration Protocol (DHCP) Server or be configured with a Fixed IP Address.
 - c. Allow MMI access to an individual Primary Network Controller using industry standard Telnet software to view and edit entire Primary Network.
5. The primary network shall provide the following minimum performance:
 - a. Provide high-speed data transfer rates for alarm reporting, report generation from multiple controllers and upload/download efficiency between network devices.
 - b. Message and alarm buffering to prevent information from being lost.
 - c. Error detection, correction, and re-transmission to guarantee data integrity.
 - d. Synchronization of real-time clocks between Primary DDC Controllers, including automatic daylight savings time corrections.
 - e. The primary network shall allow the Primary DDC Controllers to access any data from, or send control commands and alarm reports directly to, any other Primary DDC Controller or combination of controllers on the network without dependence upon a central or intermediate processing device. Primary DDC Controllers shall send alarm reports to multiple operator workstations without dependence upon a central or intermediate processing device. The network shall also allow any Primary DDC Controller to access, edit, modify, add, delete, back up, restore all system point database and all programs.

D. Secondary Network – Application Specific Controller Communication:

1. Communication over the secondary network shall be the Siemens' standard protocol and match district standards.
2. This level communication shall support a family of application specific controllers for terminal equipment.
3. The Application Specific Controllers shall communicate bi-directionally with the primary network through Primary DDC Controllers for transmission of global data.
4. Where appropriate for the equipment being installed, the short board version of the TEC shall be used to match campus standards. (p/n 540-110, 540-105)

2.3 OPERATOR INTERFACE:

A. Workstation hardware:

1. There is an existing workstation for the district; new workstations are not required with each new project or at each campus.

B. Operator Interface Software:

1. Operator interface software is the existing APOGEE Insight. All controllers must interface with the existing software and not require an additional interface to function.
 - a. Dynamic Color Graphics must match the district's standards seamlessly, including font size, color, state colors, layout, commanding and navigation.

C. Remote Access:

1. Remote access to the workstation shall be provided and maintained by the owner.

2.4 PRIMARY DDC CONTROLLER SOFTWARE

A. General

1. Furnish the following applications software to form a complete operating system for building and energy management as described in this specification. This section describes only the capability of the control system. Not all features will be used on all projects. See the mechanical plans and sequence of operation for requirements.
The software programs specified in this Section shall be provided as an integral part of Primary DDC Controllers and shall not be dependent upon any higher level computer or another controller for execution.
2. All points, panels and programs shall be identified by up to a 30-character name. All points shall also be identified by up to a 16-character point descriptor. The same names shall be displayed at both Primary DDC Controller and the Operator Interface.
3. All digital points shall have a user defined two-state status indication with up to 8 characters (e.g., Summer, Enabled, Disabled, Abnormal).
4. Primary DDC Controllers shall have the ability to perform energy management routines including but not limited to time of day scheduling, calendar-based scheduling, holiday scheduling, temporary schedule overrides, start stop time optimization, automatic daylight savings time switch over, night setback control, enthalpy switch over, peak demand limiting, temperature-compensated duty cycling, heating/cooling interlock, supply temperature reset, priority load shedding, and power failure restart. Specific routines shall be determined by the mechanical plans and sequence of operation.
5. The Primary DDC Controllers shall have the ability to perform the following pre tested control algorithms:
 - a. Two position control
 - b. Proportional control
 - c. Proportional plus integral control
 - d. Proportional, integral, plus derivative control
 - e. Automatic tuning of control loops
 - f. Model-Free Adaptive Control

B. System Security

1. User access shall be secured using individual security passwords and user names.
2. Passwords shall restrict the user to the objects, applications, and system functions as assigned by the system manager.
3. User Log On/Log Off attempts shall be recorded.

C. User Defined Control Applications

1. Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
2. It shall be possible to use any system measured point data or status, any system calculated data, a result from any process, or any user-defined constant in any controller in the system.
3. Any process shall be able to issue commands to points in any and all other controllers in the system.
4. Each controller shall support plain language text comment lines in the operating program to allow for quick troubleshooting, documentation, and historical summaries of program development.

D. Scheduling

1. Scheduling shall be created on the Insight workstation or at the panel.
2. Schedules shall reside in the Primary DDC Controller and shall not rely on external processing or network.
3. The operator shall be able to define the following information:
 - a. Time, day
 - b. Commands such as on, off, auto, etc.
 - c. Time delays between successive commands.
 - d. There shall be provisions for manual overriding of each schedule by an authorized operator.
4. It shall be possible to schedule calendar-based events up to one year in advance based on the following:
 - a. Weekly Schedule. Provide separate schedules for each day of the week. Each of these schedules should include the capability for start, and stop, optimal start, optimal stop, and night economizer. When a group of objects are scheduled together as an Event, provide the capability to adjust the start and stop times for each member.
 - b. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by the standard schedule for that day of the week.
 - c. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.

- E. Automatic Daylight Savings Time Switchover: The system shall provide automatic time adjustment for switching to/from Daylight Savings Time.
- F. Night setback control. The system shall provide the ability to automatically adjust setpoints for night control.
- G. Loop Control. A Model-Free Adaptive Control algorithm or alternatively a PID (proportional-integral-derivative) closed-loop control algorithm with direct or reverse action and anti-windup shall be supplied. The algorithm shall calculate a time-varying analog value that is used to position an output or stage a series of outputs. The controlled variable, setpoint, and weighting parameters shall be user-selectable.
- H. Sequencing. Provide application software based upon the sequences of operation specified to properly sequence equipment.
- I. Totalization
 - 1. Run-Time Totalization. Primary DDC Controllers shall have the ability to automatically accumulate and store run-time hours for all digital input and output points. A high runtime alarm shall be assigned, if required, by the operator.
 - 2. Consumption totalization. Primary DDC Controllers shall have the ability to automatically sample, calculate and store consumption totals on a daily, weekly or monthly basis for all analog and digital pulse input type points.
- J. Data Collection
 - 1. A variety of historical data collection utilities shall be provided to manually or automatically sample, store, and display system data for all points.
 - 2. Primary DDC Controllers shall store point history data for selected analog and digital inputs and outputs:
 - a. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each Primary DDC Controllers point group. Trending data to follow district standards.
 - 3. Trend data shall be stored at the Primary DDC Controllers and uploaded to the workstation when retrieval is desired. Uploads shall occur based upon either user-defined interval, manual command or when the trend buffers are full. All trend data shall be available for use in third-party personal computer applications.

2.5 PRIMARY DDC CONTROLLERS

- A. Primary DDC Controllers shall be the Siemens Apogee PXC product line. If the PXC product line is being retired, the Primary DDC Controllers shall be of the current Siemens Apogee product line.
- B. Primary DDC Controllers shall be 32-bit, multi-tasking, multi-user, real-time 100 MHz digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point list.

- C. Each Primary DDC Controller shall have sufficient memory, a minimum of 24 megabyte, to support its own operating system and databases, including control processes, energy management applications, alarm management applications, historical/trend data for points specified, maintenance support applications, custom processes, operator I/O, and dial-up communications.
- D. Provide Universal I/O capability, including software configurable universal inputs and universal outputs.
- E. Primary DDC Controller shall have an integral real-time clock.
- F. Each Primary DDC Controller shall support firmware upgrades without the need to change hardware.
- G. Each Primary DDC Controller shall support:
 - 1. Monitoring of industry standard analog and digital inputs, without the addition of equipment outside the Primary DDC Controller cabinet.
 - 2. Monitoring of industry standard analog and digital outputs, without the addition of equipment outside the Primary DDC Controller cabinet.
- H. Manual Override. Where available as a standard option, the operator shall have the ability to manually override automatic or centrally executed commands at the Primary DDC Controller via local, point discrete, integral hand/off/auto operator override switches for all digital control type points and gradual switches for all analog control type points. These override switches shall be operable whether the panel processor is operational or not. Each Primary DDC Controller shall monitor and alarm the hand, off and auto positions of integral HOA switches.
- I. Self Diagnostics. Each Primary DDC Controller shall continuously perform self diagnostics, communication diagnosis, and diagnosis of all panel components. The Primary DDC Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication for any system.
- J. Power loss. In the event of the loss of power, the database or operating system software shall be saved with a battery backup. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 30 days.
 - 1. Upon restoration of normal power, the HVAC Mechanical Equipment Controller shall automatically resume full operation without manual intervention.
 - 2. Should HVAC Mechanical Equipment Controller memory be lost for any reason, the user shall have the capability of reloading the HVAC Mechanical Equipment Controller via the local RS-232C port, via telephone line dial-in or from a network workstation PC.
- K. Immunity to power and noise.
 - 1. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.
 - a. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

- L. Panel Layout
 - 1. Each panel with hardwired points shall have a panel layout diagram included in the enclosure showing the point address, point name, and a description.
 - M. HVAC Mechanical Equipment Controllers shall provide a RS 232C serial data communication port for operation of operator I/O devices such as industry standard printers, operator terminals, modems and portable laptop operator's terminals.
- 2.6 APPLICATION SPECIFIC CONTROLLERS (ASC) – TERMINAL EQUIPMENT CONTROLLERS (TEC'S)
- A. General
 - 1. Where appropriate and specified on the mechanical plans and sequence of operation, TEC's shall be provided for the following:
 - a. Variable Air Volume (VAV) boxes
 - b. Constant Air Volume (CAV) boxes
 - c. Reheat Coils (RH)
 - d. Fan Coil Units (FCU)
 - e. Unit Conditioners
 - f. Heat Pumps
 - g. Roof Top Units (RTU's)
 - 2. Each Primary DDC Controller shall be able to communicate with application specific controllers (ASCs) over the Secondary Network to control terminal equipment only.
 - 3. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, digital control processor.
 - 4. Each ASC shall include all point inputs and outputs necessary to perform the specified control sequences. The ASC shall accept input and provide output signals that comply with industry standards. Controllers utilizing proprietary control output signals shall not be acceptable. Outputs utilized either for two-state, modulating floating, or proportional control, allowing for additional system flexibility.
 - 5. Space Temperature Sensors. Each controller performing space temperature control shall be provided with a matching space temperature sensor.
 - a. As a standard for occupied spaces such as classrooms and offices, room temperature sensors shall be Siemens Series 2000 with display, temperature adjustment, override button, and auxiliary communication port.
 - b. As a standard for hallways, room temperature sensors shall be flush mounted.
 - 6. Communication. Each controller shall perform its primary control function independent of other Secondary Network communication, or if Secondary Network communication is interrupted. Reversion to a fail-safe mode of operation during Secondary Network interruption is not acceptable.
 - 7. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration.

8. Power Supply. The ASCs shall be powered from a 24 Vac source and shall function normally under an operating range of 18 to 28 Vac, allowing for power source fluctuations and voltage drops. Power supply for the ASC must be rated at a minimum of 125% of ASC power consumption and shall be of the fused or current limiting type.
9. Environment. The controllers shall function normally under ambient conditions of 32 to 122°F (0 to 50°C) and 10% to 95% rh (non-condensing). Provide each controller with a suitable cover or enclosure to protect the circuit board assembly.
10. Immunity to noise. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

2.7 INPUT/OUTPUT INTERFACE:

- A. Hardwired inputs and outputs may tie into the system through Primary DDC Controllers, ASC's or point modules.
- B. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24V of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Binary inputs shall allow the monitoring of On/Off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against the effects of contact bounce and noise. Binary inputs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.
- D. Pulse accumulation input objects. This type of object shall conform to all the requirements of binary input objects and also accept up to ten (10) pulses per second for pulse accumulation.
- E. Analog inputs shall allow the monitoring of low-voltage (0 to 10 Vdc), current (4 to 20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with—and field configurable to—commonly available sensing devices.
- F. 24 Vdc shall be available next to the point signal for powering the output device.
- G. Binary outputs shall provide for On/Off operation or a pulsed low-voltage signal for pulse width modulation control. Outputs shall be selectable for either normally open or normally closed operation.
- H. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 Vdc or 4 to 20 mA signal as required to provide proper control of the output device.
- I. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted

heating coils, zone dampers, radiation, etc.). Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

2.8 POWER SUPPLIES AND LINE FILTERING

- A. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

2.9 FIELD DEVICES

- A. Provide instrumentation as specified on the mechanical plans and as required to meet the sequence of operation. Provide instrumentation to match district standards.

- B. Temperature Sensors

- 1. Room Temperature Sensors

- a. As a standard for occupied spaces such as classrooms and offices, room temperature sensors shall be Siemens Series 2000 with display, temperature adjustment, override button, and auxiliary communication port.
 - b. As a standard for hallways, room temperature sensors shall be flush mounted, Siemens 540-995, 540-520, 544-973 or 544-374

- 2. Liquid Immersion Temperature Sensors

- a. Temperature monitoring range: +30/250 deg F
 - b. Output Signal: Changing resistance
 - c. Accuracy at Calibration Point: +/- 0.5 deg F
 - d. Siemens Model 544 100 ohm Platinum RTD

- 3. Duct Temperature Sensors

- a. Connected to a DDC Controller
 - 1) Single Point for supply air and return air: Siemens Model 544 100 ohm Platinum RTD
 - 2) Averaging for mixed air: Siemens Model 544 100 ohm Platinum RTD
 - b. Connected to a TEC
 - 1) Single Point, 100,000 ohms , Siemens Model 536-811

- 4. Outside Air Sensor

- a. Temperature Monitoring Range: -58/122 deg F
 - b. Output Signal: 4 to 10 mA DC
 - c. Accuracy at Calibration Point: +/- 0.5 deg F

- C. Humidity Sensor

1. Room Sensors
 - a. Siemens Model QFA
 - b. Accuracy of 5% at room temperature of 73 deg F
 2. Duct Sensor
 - a. Siemens Model QFM
 - b. Accuracy of 5% at temperature of 73 deg F
- D. Air Quality Sensor
1. Room Sensor
 - a. Siemens Model QPA
 - b. Less than or equal to +/- 50 ppm +2% of measured value
 2. Duct Sensor
 - a. Siemens Model QPM
 - b. Less than or equal to +/- 50 ppm +2% of measured value
- E. Line Voltage Thermostats
1. Powers 134-1084
- F. Liquid Differential Pressure Transmitter
1. Ranges: 0-25 PSI, 0/50 PSI, 0/100 PSI
 2. Output: 4 – 20 mA DC
 3. Calibration Adjustments: Zero and span
 4. Accuracy: +/-0.2% of FS
 5. Linearity: +/-0.1% of FS
 6. Hysteresis: +/-0.05% of FS
- G. Airflow Switch
1. Siemens Model SW141
 2. Set point ranges: 0.5" WG to 1.0" WG, 1.0" WG to 12.0" WG
- H. Air Differential Pressure Sensor
1. Range shall be appropriate for the application
 2. Output signal: 4 to 20 mA
 3. Accuracy: +/- 1.0% of FS
- I. Door Contacts

1. Sensors shall be by Sentrol.

J. Electric Damper Actuators

1. All actuators shall be manufactured, brand labeled, or distributed by Siemens. Siemens Model GMA, GCA, or GDE as appropriate
2. The actuator shall have mechanical or electronic stall protection to prevent damage to the actuator throughout the rotation of the actuator.
3. All 24 Vac/Vdc actuators shall operate on Class 2 wiring.
4. Upon start up and after power loss, the actuator must immediately respond to control signals. Actuators requiring calibration to determine end stops are not acceptable.
5. All actuators that provide a factory mounted electrical appliance or plenum rated cabling must be marked with numbers on the wires as well as color coded.
6. Provide built-in dual end switches as required for the sequence of operation.
7. Actuators shall be designed for mounting directly to the damper shaft without the need for connecting linkages.
8. All actuators having more than 100 lb-in torque output shall have a self-centering damper shaft clamp that guarantees concentric alignment of the actuator's output coupling with the damper shaft. The self-centering clamp shall have a pair of opposed "v" shaped toothed cradles; each having two rows of teeth to maximize holding strength. A single clamping bolt shall simultaneously drive both cradles into contact with the damper shaft.

K. Automatic Control Valves

1. All control valves shall have electric actuator.
2. Control valves shall be sized for a maximum 5 psi pressure drop and be pressure dependent.
3. Control valves shall be of equal percentage flow characteristics for modulating service.
4. As appropriate, control valves on terminal equipment shall be Siemens Model MT or MZ valves with 3pt floating actuators with brass or bronze trim.
5. As appropriate, control valves on chilled water or hot water coils shall be Siemens Flowrite globe valves with brass or bronze trim. The actuator shall take a 0-10VDC control signal and 24VAC power.
6. Control valves 2" and smaller shall have screwed ends. Control valves 2 1/2" and larger shall be flanged.
7. Butterfly valves shall be Tyco or Bray.

PART 3 – EXECUTION

3.1 COORDINATION

A. Site

1. The project coordination between trades is the responsibility of the prime contractor who is the one tier higher contractual partner such as mechanical contractor, general contractor, construction manager, owner or owner's representative as applicable.
2. The controls contractor shall follow prime contractor's job schedule and coordinate all project related activities through the prime contractor except otherwise agreed or in minor job site issues. Reasonable judgment shall be applied.

B. Project Management

1. Provide a designated project manager who will be responsible for the following:
 - a. Coordinate with all applicable trades and subcontractors
 - b. Authorized to accept and execute orders or instructions from owner/architect
 - c. Attend project meetings as necessary to avoid conflicts and delays
 - d. Make necessary field decisions relating to this scope of work
 - e. Coordination/Single point of contact

C. Life Safety

1. Duct smoke detectors required for air handler shutdown are supplied under Division 16 of this specification. Wiring for fan shut down by Div. 16
2. Fire/smoke dampers and actuators required for fire rated walls are provided under another Section of Division 15. Control of these dampers shall be by Division 16.

D. Coordination with controls specified in other sections or divisions.

1. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:
 - a. Each supplier of controls product is responsible for the configuration, programming, startup, and testing of that product to meet the sequences of operation described in this section.

3.2 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install all equipment in readily accessible locations
- D. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.3 WIRING

- A. All control and interlock wiring shall comply with national and local electrical codes and Division 16 of this specification.
- B. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub fused when required to meet Class 2 current limit.)

- C. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables may be run not in conduit provided that cables are UL Listed for the intended application. For example, cables used in ceiling plenums shall be UL Listed specifically for that purpose.
- D. All wiring in mechanical, electrical, or service rooms shall be installed in conduit.
- E. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- F. All plenum rated wiring shall be installed as continuous lengths, with no splices permitted between termination points
- G. All wiring in conduit shall be installed as continuous lengths, with no splices permitted between termination points or between junction boxes.
- H. Size and type of conduit and size and type of wire shall be the responsibility of the contractor, in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.

3.4 COMMUNICATION WIRING

- A. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.
- B. Do not install communication wiring in raceway and enclosures containing Class 1 wiring.
- C. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
- D. All communication wiring shall be labeled to indicate origination and destination data.

3.5 PROGRAMMING

- A. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free within the primary controller for future use.
- B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index. Point Naming standard shall be agreed upon between owner and BAS contractor.
- C. Software Programming shall be complete to provide a fully functional system that matches district standards and the sequence of operation.
- D. Operator Interface
 - 1. Standard graphics—Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air

handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as setpoints.

2. All graphics shall match existing district standards.
3. The contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and its functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.

3.6 CONTROL SYSTEM CHECKOUT AND TESTING

- A. The controls contractor shall verify the installation and performance of the control system and verify that it meets the design intent. Contractor shall follow their company standard practices.
- B. District representative shall be invited to observe the startup process. Construction schedule and activities shall not be modified to accommodate the district representative.

3.7 TRAINING

- A. The Contractor shall provide competent instructors to give full instruction to designated personnel in the adjustment, operation and maintenance of the system installed. Factory employed/certified instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. All training shall be held during normal work hours of 8:00 a.m. to 4:30 p.m. weekdays.
- B. Provide 16 hours of site specific training for Owner's operating personnel.
- C. Training shall include demonstration of the system at the workstation and an on-site tour of panel, sensor, and equipment locations.

3.8 SEQUENCE OF OPERATION

- A. Provide fully implemented application and custom software and controls necessary to accomplish the control sequences required for operation of each unit as follows:
 1. Package Unit Control
 2. Air Handlers
 3. VAV Terminal Units
 4. Exhaust Fans
 5. Split Systems
 6. Utilities Metering
 7. Lighting
- B. This is a general sequence of operation. Controls contractor to modify the sequence of operation to match equipment being installed and maintain district standards.
- C. Units shall be enabled by the DDC System via occupancy schedule.

- D. Momentary "After Hours Call" switches, located on each space temperature sensor shall allow occupants to operate the system during unscheduled periods. Each activation of this switch shall provide operation for the next 2 hours.
- E. Roof Top Unit Control
 - 1. Where appropriate, the short board form the TEC shall be utilized to match district standards.
 - 2. When reasonable, the TEC's shall be mounted above the room temperature sensor in the ceiling space.
 - 3. Terminal Equipment Controllers shall monitor and control the temperature in the rooms. The Tenant will be able to adjust the space temperature setpoint via the space sensor; the district can enable or disable the setpoint dial at the workstation. If the temperature exceeds a preset reference temperature an alarm will be generated back to the OWS.
 - 4. One hour prior to tenant occupancy, the unit shall go into occupied mode; outside air shall be utilized if it is within a reasonable temperature range.
 - 5. During unoccupied modes, the unit shall control to the unoccupied set points, 58 deg for heating and 84 degrees for cooling. The fan shall cycle on and off.
 - 6. Filter differential pressure shall not be monitored/or alarmed. Filter replacement shall follow the district maintenance schedule.
 - 7. Door switches shall be placed on exterior classroom and roll-up doors. When the door switch is in the "closed" position, the package unit shall be enabled to perform temperature control. When the door is not closed, the unit shall be disabled.
 - 8. The fan status and supply air temperature shall be monitored.
 - 9. Indoor Air Quality and Demand Ventilation (when available on the mechanical unit and specified on the mechanical plans)
 - a. Units with controllable outside air, return air, and exhaust air dampers are preferred.
 - b. Pre-heat and pre-cool functions may be required to implement demand control ventilation.
 - c. When available on the mechanical equipment being installed, the BAS shall control the dampers when possible. This will not apply to RTU's that come with manufacturer controlled economizer and power exhaust options.
 - d. The room CO2 shall be monitored where shown on plans. If the room CO2 rises above 800ppm, the BAS shall modulate the dampers to provide additional ventilation (when possible).
 - 10. Dry Bulb Temperature Economizer Control (when applicable on the mechanical unit and specified on the mechanical plans and sequence of operation)
- F. Air Handler Units
 - 1. Where appropriate, the short board form the TEC shall be utilized; otherwise a Primary DDC Controller shall be used.
 - 2. Where appropriate, the controller shall be mounted in a separate enclosure on the unit. The enclosure is to be outdoor rated, have an internal fan, and be located on the shady side of the unit.
 - 3. One hour prior to tenant occupancy, the unit shall go into occupied mode; outside air shall be utilized if it is within a reasonable temperature range.
 - 4. During unoccupied modes, the unit shall control to maintain the spaces at the unoccupied set points, 58 deg for heating and 84 degrees for cooling. The fan shall cycle on and off.

5. The supply fan speed shall modulate to maintain the supply air static pressure set point. The set point shall be reset based on the air flow demand of the terminal units.
6. The AHU shall modulate the heating and cooling coil valves as applicable to maintain the supply air temperature at set point.
7. Filter differential pressure shall not be monitored/or alarmed. Filter replacement shall follow the district maintenance schedule.
8. The fan status and supply air temperature shall be monitored.
9. Indoor Air Quality and Demand Ventilation (when available on the mechanical unit and specified on the mechanical plans)
 - a. Units with controllable outside air, return air, and exhaust air dampers are preferred.
 - b. When available on the mechanical equipment being installed, the BAS shall control the dampers.
 - c. The room CO2 shall be monitored where specified on the mechanical plans. If the room CO2 rises above 800ppm, the BAS shall modulate the dampers to provide additional ventilation.
10. Dry Bulb Temperature Economizer Control (when applicable on the mechanical unit and specified on the mechanical plans)
11. Upon detection of smoke in the supply air duct, the unit will automatically shutdown, work done by others.

G. VAV Terminal Units

1. The variable volume (VAV) terminal unit is controlled independent of system pressure fluctuations by a DDC Actuating Terminal Equipment Controller. The space served by the VAV terminal unit is controlled in Occupied and Unoccupied modes as follows:
2. Occupied
 - a. The VAV terminal unit is controlled within user defined maximum and minimum supply air volume settings. The controller monitors the room temperature sensor and air velocity sensor and modulates the supply air damper and reheat coil valve (where applicable) in sequence to maintain the room temperature at set point.
3. Unoccupied
 - a. The terminal unit is controlled using the night set point. The controller may reset to the Occupied mode for a predetermined time period upon a signal from the control system or manually at the room sensor.

H. Typical Exhaust Fan Control

1. The toilet exhaust fans shall be interlocked with the local light switch by Div 16.
2. General exhaust fans shall be software interlocked by the BAS to the associated units.
3. Electric room and mechanical room exhaust fans shall have a line voltage thermostat furnished by the controls contractor, installed by div.16.

I. Split Systems

1. Where possible, a TEC shall be used to control the split system unit.

2. Where control is not possible, the room temperature shall be monitored by the BAS.

J. Utilities Metering

1. The main power circuit coming into the campus shall be monitored by a Siemens Digital Energy Monitor.
2. DEM to be provided by Siemens, installed by Div 16.

K. Lighting Control

1. The exterior lights shall be controlled by the BAS.
 - a. A digital photocell shall be connected to the BAS. When the exterior lighting is scheduled to be on and the photocell is "off", the BAS shall enable the exterior lighting.
 - b. An override switch shall be located at the main entrance to the building. When activated, the exterior lighting shall be enabled regardless of scheduling or photocell activity
 - c. Exterior lighting shall be controlled by contactors furnished and installed by div. 16.
2. When a lighting control panel is used for interior lighting, the control panel shall be provided with BACnet IP communication protocol (by others).

END OF SECTION 23 09 00

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes piping, special-duty valves, and hydronic specialties for hot-water heating, chilled-water cooling, and condenser water systems; makeup water for these systems; blowdown drain lines; and condensate drain piping.
- B. Related Sections include the following:
 - 1. Division 7 Section "Through-Penetration Firestop Systems" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
 - 2. Division 7 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
 - 3. Division 23 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
 - 4. Division 23 Section "General Duty Valves for HVAC Piping" for general-duty gate, globe, ball, butterfly, and check valves.
 - 5. Division 23 Section "Meters and Gages For HVAC Piping" for thermometers, flow meters, and pressure gages.
 - 6. Division 23 Section "Identification for HVAC Piping and Equipment" for labeling and identifying hydronic piping.
 - 7. Division 23 Section "Sequence of Operations for HVAC Controls" for temperature-control valves and sensors.

1.2 DEFINITIONS

- A. CPVC: Chlorinated polyvinyl chloride.
- B. PVC: Polyvinyl chloride.

1.3 SUBMITTALS

- A. Product Data: For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.
- B. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- C. Welding Certificates: Copies of certificates for welding procedures and personnel.
- D. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
 - 1. Test procedures used.

2. Test results that comply with requirements.
 3. Failed test results and corrective action taken to achieve requirements.
- E. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 1.
- F. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.5 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Through-Penetration Firestop Systems" for fire and smoke wall and floor assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Automatic Flow-Control Valves:
 - a. Flow Design, Inc.
 - b. Griswold Controls.

- c. ITT Bell & Gossett.

2.2 PIPING MATERIALS

- A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
C. Wrought-Copper Fittings: ASME B16.22.
D. Wrought-Copper Unions: ASME B16.22.
E. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
F. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (silver).

2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2-1/2 through NPS 12: ASTM A 53, Type E (electric-resistance welded), Grade B, Schedule 40, black steel, plain ends.
B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250.
C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.
F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 1. Material Group: 1.1.
 2. End Connections: Butt welding.
 3. Facings: Raised face.
H. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
I. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

2.5 VALVES

- A. Globe, check, ball, and butterfly valves are specified in Division 23 Section "General Duty Valves for HVAC Piping."
- B. Refer to Part 3 "Valve Applications" Article for applications of each valve.
- C. Automatic Flow-Control Valves: Gray-iron body, factory set to maintain constant flow with plus or minus 5 percent over system pressure fluctuations, and equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case. Each valve shall have an identification tag attached by chain, and be factory marked with the zone identification, valve number, and flow rate. Valve shall be line size and one of the following designs:
 - 1. Gray-iron or brass body, designed for 175 psig at 200 deg F with stainless-steel piston and spring.
 - 2. Brass or ferrous-metal body, designed for 300 psig at 250 deg F with corrosion-resistant, tamperproof, self-cleaning, piston-spring assembly easily removable for inspection or replacement.
 - 3. Combination assemblies, including bronze ball valve and brass alloy control valve, with stainless-steel piston and spring, fitted with pressure and temperature test valves, and designed for 300 psig at 250 deg F.

2.6 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig working pressure; 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 discharge connection and NPS 1/2 inlet connection.
- B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection.
- C. Y-Pattern Strainers: 125-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 and larger, threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel 20 Mesh basket, and bottom drain connection.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot and Chilled Water NPS 2 and smaller: Aboveground, use Type L drawn-temper copper tubing with soldered joints. Belowground or within slabs, use Type K annealed-temper copper tubing with soldered joints. Use the fewest possible joints belowground and within slabs.
- B. Hot and Chilled Water, NPS 2-1/2 and Larger: Schedule 40 black steel pipe with grooved mechanical joint couplings.
- C. Condensate Drain Lines: Type L drawn-temper copper tubing with soldered joints.

3.2 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
 - 1. Shutoff Duty: Ball, and butterfly valves.
 - 2. Throttling Duty: Globe, ball, and butterfly valves.
- B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

3.3 PIPING INSTALLATIONS

- A. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- B. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- C. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- D. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- E. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
- F. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- G. Anchor piping for proper direction of expansion and contraction.

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports." Comply with requirements below for maximum spacing of supports.

3.5 PIPE JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping; and solvent-welded joints for PVC and CPVC piping.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents in mechanical equipment rooms only at high points of system piping, at heat-transfer coils, and elsewhere as required for system air venting.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be same as for equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If multiple, parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure and temperature gages at coil inlet connections.

3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush system with clean water. Clean strainers.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
 - 3. Check expansion tanks to determine that they are not air bound and that system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping." Coordinate with Owner's representative so that owner may witness testing.
 - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 6. Prepare written report of testing.

3.9 ADJUSTING

- A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- B. Perform these adjustments before operating the system:
 - 1. Open valves to fully open position. Close coil bypass valves.
 - 2. Check pump for proper direction of rotation.
 - 3. Set automatic fill valves for required system pressure.
 - 4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 - 5. Set temperature controls so all coils are calling for full flow.
 - 6. Check operation of automatic bypass valves.
 - 7. Lubricate motors and bearings.

3.10 CLEANING

- A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens.

END OF SECTION 23 21 13

SECTION 23 21 16 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes special-duty valves and specialties for the following:

1. Hot-water heating piping.
2. Makeup-water piping.
3. Condensate-drain piping.
4. Blowdown-drain piping.
5. Air-vent piping.
6. Safety-valve-inlet and -outlet piping.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of the following:

1. Air-control devices.
2. Hydronic specialties.

1.03 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, and hydronic specialties, to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 125 psig 200 deg F.
2. Makeup-Water Piping: 80 psig at 150 deg F.
3. Condensate-Drain Piping: 150 deg F.
4. Blowdown-Drain Piping: 200 deg F .
5. Air-Vent Piping: 200 deg F.
6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.02 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 230523 "General-Duty Valves for HVAC Piping."Section 15112 "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230900 "Direct Digital Controls."

C. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: Stainless Steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

D. Diaphragm-Operated Safety Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Conbraco Industries, Inc.
 - d. Spence Engineering Company, Inc.
 - e. Watts Regulator Co.
 - f. Kunkle; Division of Pentair.
2. Body: Bronze.
3. Spring: Steel Alloy
4. Seat: Silicone.
5. Valve Seat and Stem: Noncorrosive.
6. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.03 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Nexus Valve, Inc.
 - e. Taco, Inc.
 2. Body: Bronze.
 3. Internal Parts: Nonferrous.
 4. Operator: Screwdriver or thumbscrew.
 5. Inlet Connection: NPS 1/2 (DN 15).
 6. Discharge Connection: NPS 1/8 (DN 6).
 7. CWP Rating: 150 psig (1035 kPa).
 8. Maximum Operating Temperature: 225 deg F (107 deg C).
- B. Automatic Air Vents:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Nexus Valve, Inc.
 - e. Taco, Inc.
 2. Body: Bronze or cast iron.
 3. Internal Parts: Nonferrous.
 4. Operator: Noncorrosive metal float.
 5. Inlet Connection: NPS 1/2 (DN 15).
 6. Discharge Connection: NPS 1/4 (DN 8).
 7. CWP Rating: 150 psig (1035 kPa).
 8. Maximum Operating Temperature: 240 deg F (116 deg C).
- C. Bladder-Type Expansion Tanks:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc.
 - e. Wessels.
 2. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

D. In-Line Coalescing Air-Dirt Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one the following:
 - a. Armstrong Products, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Taco, Inc.
 - d. Spirotherm.
2. Tank: Welded steel; ASME constructed and labeled for 150-psig minimum working pressure and 375 deg F maximum operating temperature.
3. Air Collector Bundle: Copper core tube with wound copper medium permanently affixed to core.
4. In-line Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
5. Blowdown Connection: Threaded and valved.
6. Size: Match system flow capacity; entering velocity not to exceed 4 ft/second.
7. Automatic Vent: Located at top of venting chamber.
8. Capable of removing 100% of free and entrained air, 99.6% of dissolved air and 80% of dirt particles greater than 30 micron within 100 passes.

2.04 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Mueller Steam Specialty.
 - b. Watts.
 - c. Keckley
2. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
4. Strainer Screen: Stainless-steel, 40-mesh strainer, or perforated stainless-steel basket.
5. CWP Rating: 125 psig (860 kPa).

B. Spherical, Rubber, Flexible Pump Connectors:

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. Metraflex
 - b. Mason Industries
 - c. Flexicraft

2. Body: EPDM rubber body.
3. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
4. Performance: Capable of misalignment.
5. CWP Rating: 150 psig (1035 kPa).
6. Maximum Operating Temperature: 220 deg F (121 deg C).

PART 3 - EXECUTION

3.01 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- C. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- D. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.02 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install in-line air-dirt separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.
- E. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 23 21 16

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 185 psig.
 - 2. Suction Lines for Heat-Pump Applications: 325 psig.
 - 3. Hot-Gas and Liquid Lines: 325 psig.

1.3 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

- A. Service Valves:
 - 1. Body: Forged brass with brass cap including key end to remove core.
 - 2. Core: Removable ball-type check valve with stainless-steel spring.
 - 3. Seat: Polytetrafluoroethylene.
 - 4. End Connections: Copper spring.
 - 5. Working Pressure Rating: 500 psig.
- B. Thermostatic Expansion Valves: Comply with ARI 750.
 - 1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 - 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 - 3. Packing and Gaskets: Non-asbestos.
 - 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 - 5. Suction Temperature: 40 deg F.

6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 700 psig.

C. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

D. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Designed for reverse flow (for heat-pump applications).
4. End Connections: Socket.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

2.3 REFRIGERANTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

B. ASHRAE 34, R-410A.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Suction Lines NPS 4 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install service valves for gage taps at strainers if they are not an integral part of strainers.
- B. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.
- C. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- D. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- E. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- F. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.

- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- Q. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- S. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- T. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.

3.4 PIPE JOINT CONSTRUCTION

- A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
 - 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 1. Open shutoff valves in condenser water circuit.
 2. Verify that compressor oil level is correct.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves except bypass valves that are used for other purposes.
 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

END OF SECTION 23 23 00

SECTION 23 25 00 - HVAC WATER TREATMENT

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

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

1.02 PRINCIPAL WORK IN THIS SECTION

- A. Chemical feeder equipment.
- B. Chemical treatment.

1.03 LOCAL QUALITY ASSURANCE

- A. All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture.
- B. Supply all equipment and accessories new and free from defects.
- C. All items of a given type shall be the products of the same manufacturer.
- D. Intent of this Section is to provide complete chemical treatment to protect following systems from scale formations, corrosion, algae and slime growth:
 - 1. Heating hot water piping.

1.04 SUBMITTALS

- A. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.
- B. Product Data: Chemical treatment materials, chemicals, and equipment, including electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Indicate placement of equipment within systems, piping configuration, and connection requirements.
- D. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment. (See Preoperational Cleaning.)

1.05 OPERATION AND MAINTENANCE DATA

- A. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with Five years experience.

1.07 DESCRIPTION OF WATER TREATMENT SERVICE

- A. Retain qualified water treatment firm for complete water treatment service including:
 - 1. Perform analysis of water conditions.
 - 2. Supervised installation of water treatment equipment.
 - 3. Furnishing and application of all chemicals from startup thru acceptance by owner.
- B. Treatment period:
 - 1. Water treatment applied concurrently with operation of each system from startup thru final acceptance by Owner.

1.08 REGULATORY REQUIREMENTS

- A. All products and chemicals shall meet federal, state, and local government regulations

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Water Treatment Chemicals & Service:
 - 1. Trident Technologies, Inc
 - 2. Aqua-Serv Eng. Inc.
 - 3. Nalco Chemical Co.
- B. Metering Pumps, Feeders, Tanks & Water meters:
 - 1. Precision Control Products Corp.
 - 2. Pulsafeeder.
 - 3. LMI.
 - 4. Neptune
 - 5. Clawson
 - 6. Peabody
 - 7. Carlon
 - 8. Seametrics
 - 9. Hersey
- C. Automatic Command & Control Systems:
 - 1. Aquatrac Instruments
- D. System Components:
 - 1. Water Meters: Turbine or rotating disk positive displacement type with integral pulse unit, bronze base and bronze internal carbon ball design to totalize water input in gallons with a

99 percent min accuracy. Locate in Cooling tower makeup, and bleed, chilled water makeup line and soft water makeup to boiler feed water tank. Note: Aquatrac will log all meter readings.

2. Chemical Storage systems: Provide secondary containment Tanks for all chemicals. Water treatment supplier to size tanks proportionate to system tonnage and horsepower.
3. Injection assembly: Chemical injector/check valve assemblies to be supplied with each chemical pump. Stainless steel corporation stops are to be provided for acid and inhibitor feeds. A PVC corporation stop is to be provided for brominator.
4. Solenoid valves: Power operated NC valves installed in condenser bleed off line and for automatic brominator operation.
5. Motorized Ball valves: Motorized blowdown valves (min $\frac{3}{4}$ ") 120vac, rated 250 psi steam for boiler blowdown.
6. Coupon Racks: Install coupon rack in condenser and chill water systems. Each rack shall have four coupon holders. Maximum flow rate 5gpm.
7. Piping: All cooling water treatment piping (sensors, coupon racks, etc) shall be min. sched 80 PVC. All cooling water chemical injection line piping shall be sched 80 CPVC.

2.02 WATER TREATMENT

A. Closed circulation water system:

1. Trident Prod #5303 Closed system Inhibitor.
2. Trident Prod # 8002 Cleaner
3. Typical of:
 - a. Hot water system.
 - b. Chilled water and Closed loop condenser water systems.

B. Boiler water Treatment:

1. Trident Prod #2002 Oxygen Scavenger
2. Trident Prod #1102 Organic Inhibitor
3. Trident Prod #1605 Antifoam
4. Trident Prod #1003 Alkalinity Supplement
5. Trident Prod #3506 Condensate Treatment

2.03 CHEMICAL FEEDERS

A. Feed systems for condenser water system.

1. Proportioning, diaphragm type chemical pumps: Separate pumps for Inhibitor, Acid, Dispersant, and liquid Microbiocides.
2. Feed rate: Size all chemical pumps to job.
3. Provide solenoid operated brominator for solid bromine feed.

B. Feed systems for boiler water system:

1. Pumps: as specified for condenser water system.
2. Boiler Water Treatment Controls:
 - a. Provide Controller interlock with boiler on/off operation.
 - b. Automatically control boiler water conductivity and chemical feed in response to makeup, timed feed, or blowdown.

1. Blowdown Conductivity controller: Aquatrac Instruments
 2. Model # MULTIFLEX M5B-B2-TB2-RC (This will control two boilers)
- C. By-pass type feeder for closed circulating water systems.
1. Capacity: Minimum 5 gallons. (Size to job)
 2. Steel shell and heads.
 3. Cap: Cast iron with Buna N "O" ring.
 - a. Quarter-turn to open.
 4. $\frac{3}{4}$ " taps for water in and out and drain.
 5. Operating pressure and temperature:
 - a. Operating pressure up to 175 psi.
 - b. Temperature up to 212°F.
 - c. Design and installation as indicated.
 6. For chilled water system, insulated.
 7. Similar to JL Wingert Model 5HD

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Chemical Feed Systems and Control Equipment
- B. Feed system piping connections, valves, wiring, Controller and feeder locations shall be approved (in writing at jobsite) by water treatment firm **PRIOR** to installation by contractor.

3.02 PREOPERATIONAL SYSTEM CLEANING

- A. The purpose of pre-operational cleaning of newly installed mechanical systems and piping is the removal of preservatives, cutting oils, pipe dope and other contaminants prior to the injection of corrosion and deposit inhibiting chemicals and startup operation. This process is critically important to the success of the continuing water treatment program. All closed hot and boiler water systems and related piping shall be thoroughly flushed out with a specially formulated cleaner. Since these types of cleaners will raise the pH of the water to which they are added. It is not recommended that they be introduced to cooling towers or evaporative condensers manufactured of galvanized sheet metal as "white rust" may develop on the metal surfaces.

Procedures, Closed Systems:

Once the system has been completely installed, with temporary strainers in place, the proper amounts of cleaner should be added through the one shot chemical feeder. The cleaner should raise the pH of the system to 10.0-11.0. The cleaning solution should be circulated for 24-48 hours depending on the type of system. The success of preoperational cleaning procedures is largely dependent on flow velocities. It is very important that all control valves are open and that cleaning solution is in contact with all internal surfaces of the system. The cleaning solution should be circulated using the system recirculation pumps or temporary pumps depending on the design characteristics and construction scheduling. The flow velocity should be a minimum of 5 feet per second. Once the cleaning solution has been circulated for the desired time the system

should be drained and flushed using the automatic makeup water system for supply. The temporary strainers should be removed and replaced with permanent strainers. The water should be analyzed with the following targets:

Test	Target
pH	Same as the makeup water
Specific Conductance	Same as the makeup water
Fe	< 1.0 ppm

Once the water quality is equal to the target limitations the system can be considered clean and ready to accept the initial charge of chemical inhibitors. It is important that inhibitors and passivating agents are added to the system within 24 hours to prevent the corrosion and flash rusting. Untreated water shall not be allowed to remain in the system for more than 24 hours.

Procedures, Boilers:

Be sure the boiler is isolated at the steam header and that temporary site glasses have been installed. Add softened water to the boiler together with the proper amount of Trident 8002 pre-operational cleaner. The cleaning solution will be alkaline between 10.0- 11.0. The boiler should be fired to raise the temperature of the solution to 170 degrees and maintained for 24 hours. The boiler should be drained and flushed and refilled with clean softened water the water should have < 1.0 ppm Fe and conductivity equal to that of the makeup water. The system should then be initially charged with chemicals to prevent corrosion.

3.03 SCHEDULES

- A. Provide installation supervision and start-up of automatic water treatment systems by qualified representative of equipment manufacturer.
 - 1. Provide minimum of 4 hours instruction for closed loop condenser water system.
- B. Each system operation to Owners operating personnel.

END OF SECTION 23 25 00

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round and flat-oval ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Duct liner.
 - 5. Sealants and gaskets.
 - 6. Hangers and supports.
 - 7. Seismic-restraint devices.

- B. Related Sections:

- 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Section 233116 "Nonmetal Ducts" for FRP ducts.
 - 3. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements, California Mechanical Code, and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", California Mechanical Code, and ASCE/SEI 7.
 - 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.

- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
 - 3. Seismic-restraint devices.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 - 4. Elevation of top of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.
 - 9. Penetrations through fire-rated and other partitions.
 - 10. Equipment installation based on equipment being used on Project.
 - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 - 12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- C. Delegated-Design Submittal:
 - 1. Sheet metal thicknesses.
 - 2. Joint and seam construction and sealing.
 - 3. Reinforcement details and spacing.
 - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
 - 5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.
 - 3. Structural members to which duct will be attached.

4. Size and location of initial access modules for acoustical tile.
 5. Penetrations of smoke barriers and fire-rated construction.
 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
- B. Welding certificates.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. Spiral Manufacturing Co., Inc.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods

unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. Rubatex International, LLC.
 2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 3. Butt transverse joints without gaps, and coat joint with adhesive.
 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.

- c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
- 9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
- 10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 8. Service: Indoor or outdoor.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Electrogalvanized, all-thread rods or galvanized rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- E. Steel Cable End Connections: Galvanized steel assemblies, complying with ASTM A 603, with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.7 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Mason Industries, Inc.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- D. Restraint Cables: ASTM A 603, galvanized or ASTM A 492, stainless-steel cables with end connections made of galvanized or stainless steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines".
- M. Line the first 20 feet length of connected supply and return ducts at each package rooftop A/C unit, for noise attenuation and thermal insulation (unless noted otherwise on drawings).

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports, unless indicated otherwise on drawings.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7.
1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099000 "Painting."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 2. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch wg:
 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 4. Test for leaks before applying external insulation.
 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 6. Give seven days advance notice for testing.
- C. Duct System Cleanliness Tests:
 1. Visually inspect duct system to ensure that no visible contaminants are present.

2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
 - D. Duct system will be considered defective if it does not pass tests and inspections. If a duct system fails to pass tests and inspections, the entire duct system shall be cleaned and re-tested again at no additional cost to owner.
 - E. Prepare test and inspection reports.
- 3.9 DUCT CLEANING
- A. Clean new duct system(s) before testing, adjusting, and balancing.
 - B. Use service openings for entry and inspection.
 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 3. Remove and reinstall ceiling to gain access during the cleaning process.
 - C. Particulate Collection and Odor Control:
 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
 - D. Clean the following components by removing surface contaminants and deposits:
 1. Air outlets and inlets (registers, grilles, and diffusers).
 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 3. Air-handling unit internal surfaces and components including mixing box, coil section, condensate drain pans, filters and filter sections, and condensate collectors and drains.
 4. Coils and related components.
 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 6. Supply-air ducts, dampers, actuators, and turning vanes.
 7. Dedicated exhaust and ventilation components and makeup air systems.
 - E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel.
- B. Supply Ducts:
 1. Pressure Class: Positive 2-inch.
 2. Minimum SMACNA Leakage Class: 12
 3. SMACNA Leakage Class for Rectangular: 12
- C. Return Ducts:
 1. Pressure Class: Positive or negative 2-inch.
 2. Minimum SMACNA Seal Class: A
 3. SMACNA Leakage Class for Rectangular: 12.
- D. Exhaust Ducts:
 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 24.
 2. Ducts Connected to Package A/C units and Air-handling units:

- a. Pressure Class: Positive or negative 2-inch wg.
- b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
- c. SMACNA Leakage Class for Rectangular: 24.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

F. Liner:

1. Air Ducts (except ducts serving Food Prep and Cafeteria): Fibrous glass, Type I, 2 inches thick.
2. Fan Plenums (except ducts serving Food Prep and Cafeteria): Fibrous glass, Type II, 2 inches thick.
3. Food Prep/Cafeteria air ducts and fan plenums: Flexible elastomeric 2-inches thick.

G. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Backdraft dampers.
 - 2. Volume dampers.
 - 3. Turning vanes.
 - 4. Duct-mounting access doors.
 - 5. Flexible connectors.
 - 6. Flexible ducts.
 - 7. Duct accessory hardware.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Backdraft dampers.
 - 2. Volume dampers.
 - 3. Turning vanes.
 - 4. Duct-mounting access doors.
 - 5. Flexible connectors.
 - 6. Flexible ducts.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

- A. Comply with 2016 California Mechanical Code for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT DAMPERS

- A. Manufacturers:
 1. Duro Dyne Corp.
 2. Greenheck.
 3. Ruskin Company.
- B. Description: Multiple-blade, parallel action gravity balanced, with blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.
- C. Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners and mounting flange.
- D. Blades: 0.050-inch- thick aluminum sheet.
- E. Blade Seals: Neoprene.
- F. Blade Axles: Galvanized steel.
- G. Tie Bars and Brackets: Galvanized steel.
- H. Return Spring: Adjustable tension.

2.4 VOLUME DAMPERS

- A. Manufacturers:
 1. Flexmaster U.S.A., Inc.
 2. METALAIRE, Inc.

3. Ruskin Company.
 - B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 - C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
 1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
 3. Blade Axles: Galvanized steel.
 4. Bearings: Oil-impregnated bronze.
 5. Tie Bars and Brackets: Galvanized steel.
 - D. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
 - E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.
- 2.5 TURNING VANES
- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
 - B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.
 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Duro Dyne Corp.
 - c. Ward Industries, Inc.
 - C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.6 DUCT-MOUNTING ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
 - 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Greenheck.
 - c. Nailor Industries Inc.
 - d. Ward Industries, Inc.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Provide number of hinges and locks as follows:
 - a. Less Than 12 Inches Square: Secure with two sash locks.
 - b. Up to 18 Inches Square: Two hinges and two sash locks.
 - c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Sizes 24 by 48 Inches and Larger: One additional hinge.
- C. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- D. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.7 FLEXIBLE CONNECTORS

- A. Manufacturers:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Corp.
 - 3. Ward Industries, Inc.
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- C. Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.

2.8 FLEXIBLE DUCTS

- A. Manufacturers:

1. Flexmaster U.S.A., Inc.
 2. Hart & Cooley, Inc.
 3. McGill AirFlow Corporation.
 4. Casco.
- B. Noninsulated-Duct Connectors: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire.
1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 20 to plus 210 deg F.
- C. Insulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor barrier film.
1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.
- D. Flexible Duct Clamps: Stainless-steel band with stainless steel hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

2.9 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

- E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
 - F. Provide test holes at fan inlets and outlets and elsewhere as indicated.
 - G. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
 - 1. On both sides of duct coils.
 - 2. Downstream from volume dampers, turning vanes, and equipment.
 - 3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
 - 4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
 - 5. On sides of ducts where adequate clearance is available.
 - H. Install the following sizes for duct-mounting, rectangular access doors:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body Plus Ladder Access: 25 by 17 inches.
 - I. Install the following sizes for duct-mounting, round access doors:
 - 1. One-Hand or Inspection Access: 8 inches in diameter.
 - 2. Two-Hand Access: 10 inches in diameter.
 - 3. Head and Hand Access: 12 inches in diameter.
 - 4. Head and Shoulders Access: 18 inches in diameter.
 - 5. Body Access: 24 inches in diameter.
 - J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment."
 - K. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
 - L. Connect diffusers or light troffer boots to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
 - M. Connect flexible ducts to metal ducts with draw bands.
- 3.2 ADJUSTING
- A. Adjust duct accessories for proper settings.

- B. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION 23 33 00

SECTION 23 34 23 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Centrifugal roof ventilators.

1.2 SUBMITTALS

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

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

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. Or Equal.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Belt Drives:
 1. Resiliently mounted to housing.
 2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 5. Fan and motor isolated from exhaust airstream.
- E. Accessories:
 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
- F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
 1. Configuration: Built-in cant and mounting flange.
 2. Overall Height: 8 inches.
 3. Sound Curb: Curb with sound-absorbing insulation.
 4. Pitch Mounting: Manufacture curb for roof slope.
 5. Metal Liner: Galvanized steel.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
- B. Enclosure Type: Totally enclosed, fan cooled.

2.3 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Secure roof-mounted fans to roof curbs with stainless steel hardware.
- B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- C. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch.
- D. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 3. Verify that cleaning and adjusting are complete.
 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 5. Adjust belt tension.
 6. Adjust damper linkages for proper damper operation.
 7. Verify lubrication for bearings and other moving parts.
 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 10. Shut unit down and reconnect automatic temperature-control operators.
 11. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

END OF SECTION 23 34 23

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Louver face diffusers.
3. Fixed face grilles.

B. Related Sections:

1. See architectural drawings for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers CD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Krueger.
 - b. METALAIR, Inc.
 - c. Price Industries.
 - d. Titus.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, white.
5. Face Size: 24 by 24 inches.
6. Face Style: Plaque.
7. Mounting: As required for ceiling type, concealed hardware.
8. Pattern: Adjustable.
9. Accessories:
 - a. Plaster ring.

B. Louver Face Diffuser SWS:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. METALAIRE, Inc.
 - b. Price Industries.
 - c. Titus.
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, white.
5. Face Size: See plans.
6. Mounting: As required for soffit type, concealed hardware.
7. Pattern: Adjustable core style.

2.2 REGISTERS AND GRILLES

A. Fixed Face Grille RG-1/EG-1/TG-1/SWR

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Krueger.
 - b. METALAIRE, Inc.
 - c. Price Industries.
 - d. Titus.
2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Arrangement: $\frac{3}{4}$ " blades spacing at 30 to 40 degree angle.
5. Frame: 1 inch wide.
6. Mounting: As required for ceiling or soffit type, concealed hardware.
7. Accessories:
 - a. Plaster frame.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 23 41 00 - PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes factory-fabricated air-filter devices and media used to remove particulate matter from air for HVAC applications.

1.2 SUBMITTALS

- A. Product Data: Include dimensions; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each unit indicated.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Comply with ARI 850.
- B. Comply with ASHRAE 52.1 and ASHRAE 52.2 for method of testing and rating air-filter units.
- C. Comply with NFPA 90A and NFPA 90B.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Airguard Industries, Inc.
 - 2. Farr Co.
 - 3. Flanders Filters, Inc.
- B. Disposable Panel Filters: Factory-fabricated, viscous-coated, flat-panel-type, disposable air filters with holding frames.
 - 1. Media: Interlaced glass fibers sprayed with nonflammable adhesive.
 - 2. Frame: Cardboard frame with perforated metal retainer.
 - 3. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners and suitable for bolting together into built-up filter banks.

- C. Extended-Surface, Disposable Panel Filters: Factory-fabricated, dry, extended-surface filters with holding frames.
 - 1. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.
 - 2. Media and Media-Grid Frame: Nonflammable cardboard.
 - 3. Duct-Mounting Frames: Welded, galvanized steel with gaskets and fasteners, and suitable for bolting together into built-up filter banks.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- B. Install filters in position to prevent passage of unfiltered air.
- C. Coordinate filter installations with duct and air-handling unit installations.

END OF SECTION 23 41 00

SECTION 23 52 16 - CONDENSING BOILERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes gas-fired, copper finned-tube condensing boilers, trim, and accessories for generating hot water.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for boilers.
 - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For boilers, boiler trim, and accessories.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For each boiler.
 - 1. Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.
 - a. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - b. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.04 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For boiler, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.
- E. Other Informational Submittals:
1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
 2. CSA B51 pressure vessel Canadian Registration Number (CRN).

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.06 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.
- B. Limited five-year warranty (copper) from date of installation
- C. Limited twenty-five-year thermal shock warranty
- D. Limited ten-year closed-system heat exchanger warranty

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASME Compliance: Fabricate and label boilers to comply with 2010 ASME Boiler and Pressure Vessel Code.
- C. ASHRAE/IES 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N.

- E. UL Compliance: Test boilers for compliance with UL 795. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.
- F. CSA Compliance: Test boilers for compliance with CSA B51.
- G. Mounting Base: For securing boiler to concrete base.
 - 1. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC" when mounting base is anchored to building structure.

2.02 WATER-TUBE CONDENSING BOILERS

- A. Manufacturers:
 - 1. Raypak, Inc.
 - 2. Lochnivar.
 - 3. Approved Equivalent
- B. Description: Factory-fabricated, -assembled, and -tested, copper-finned, water-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base, including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water-heating service only.
- C. Primary Heat Exchanger
 - 1. The primary heat exchanger shall be of a a single-bank, vertical multi-pass design and shall completely enclose the combustion chamber for maximum efficiency. The tubes shall be set vertically and shall be rolled into a powder-coated, ASME boiler quality, carbon steel tube sheet.
 - 2. The primary heat exchanger shall be sealed to 160 PSIG rated cast iron headers with silicone "O" rings, having a temperature rating over 500°F (bronze headers optional).
 - 3. The low water volume primary heat exchanger shall be explosion-proof on the water side and shall carry a twenty-five-year warranty against thermal shock.
 - 4. The headers shall be secured to the tube sheet by stud bolts with flange nuts to permit inspection and maintenance without removal of external piping connections. A heavy gauge stainless steel slotted wrap shall ensure proper combustion gas flow across the copper-finned tubes.
 - 5. The flue connection, combustion air opening, gas connection, water connections, electrical connections and condensate drain shall be located on the rear.
 - 6. The primary heat exchanger shall have accessible boiler drain valves with hose bibs to drain the water section of the primary heat exchanger.
- D. Secondary Heat Exchanger
 - 1. The secondary heat exchanger shall be a single-bank, multi-pass design constructed of stainless steel and bears the ASME U stamp.
 - 2. The boiler(s) shall be capable of operating at inlet water temperatures as low as 50°F.
- E. Condensate Drain
 - 1. The boiler(s) will feature a condensate drain switch which will shut down the boiler(s) if

the condensate drain is blocked.

F. Burners

1. The combustion chamber shall be of the sealed combustion type employing the Raypak hightemperature FeCrAloy woven mesh burner, mounted in a vertical orientation.
2. The burner must be capable of firing at both a complete blue flame with maximum gas and air input as well as firing infrared when gas and air are reduced. The burner must be capable of firing at 100% of rated input when supplied with 4.0" WC of inlet gas pressure, so as to maintain service under heavy demand conditions; no exceptions.
3. The burner shall use a combustion air blower to precisely control the fuel/air mixture for maximum efficiency throughout the entire range of modulation. The combustion air blower shall operate for a pre-purge period before burner ignition and a post-purge period after burner operation to clear the combustion chamber.
4. The blower shall infinitely vary its output in response to a 4-20 mA signal supplied directly from the PID modulating temperature controller, thereby electronically and precisely adjusting the volume of air and gas supplied for combustion. Minimum fire shall be 25 percent of rated input.

G. Pilot Control System

1. The boiler(s) shall be equipped with a 100 percent safety shutdown.
2. The ignition shall be Hot Surface Ignition type with full flame rectification by remote sensing separate from the ignition source, with a three-try-for-ignition sequence, to ensure consistent operation.
3. The igniter will be located to the side of the heat exchanger to protect the device from condensation during start-up.
4. The ignition control module shall include an LED that indicates six (6) individual diagnostic flash codes.

H. Gas Train

1. The boiler(s) shall have a firing/leak test valve and pressure test valve as required by CSD-1.
2. The boiler(s) shall have dual-seated main gas valve.
3. Gas control trains shall have a redundant safety shut-off feature, main gas regulation, shut-off cock and plugged pressure tapping to meet the requirements of ANSI Z21.13/CSA 4.9.

I. Boiler Control

1. The following safety controls shall be provided:
 - a. High limit control with manual reset
 - b. Flow switch, mounted and wired
 - c. 7 5 PSIG ASME pressure relief valve, piped by the installer to an approved drain.
 - d. Temperature and pressure gauge (shipped loose)
2. The boiler(s) shall be equipped with a PID modulating temperature controller with LCD display that incorporates an adjustable energy-saving pump control relay and freeze protection and is factory mounted and wired to improve system efficiency; three water sen-

sors included (system sensor is loose).

- J. Firing Mode: Provide electronic modulating control of the gas input to the boiler.
- K. Boiler Diagnostics
 - 1. Provide external LED panel displaying the following boiler status/faults:
 - a. Power on Green
 - b. Call for heat Amber
 - c. Burner firing – Blue
 - d. Service Red
 - 2. Provide internal circuit board indicating the following safety faults by a 2 line, 20 character, LCD display:
 - a. System status
 - b. Condensate blockage
 - c. Manual reset high limit
 - d. Auto reset high limit (optional)
 - e. Low water cut-off (optional)
 - f. Blocked vent
 - g. Low gas pressure switch (optional)
 - h. High gas pressure switch
 - i. Controller alarm
 - j. Flow switch
 - k. Air pressure
 - l. Factory option
 - m. External interlock
 - n. Cold Water Start/Cold Water Run o. Ignition lock-out
 - 3. Provide ignition module indicating the following flash codes by LED signal and displayed on LCD display:
 - a. 1 flash – low air pressure
 - b. 2 flashes – flame in the combustion chamber w/o CFH
 - c. 3 flashes – ignition lock-out (flame failure)
 - d. 4 flashes – low hot surface igniter current
 - e. 5 flashes – low 24VAC
 - f. 6 flashes – internal fault (replace module)
- K. Combustion Chamber: The combustion chamber wrapper shall be insulated to reduce standby radiation losses, reducing jacket losses and increasing unit efficiency.
- L. Cabinet
 - 1. The corrosion-resistant galvanized-steel jackets shall be finished with a baked-on epoxy powder coat, which is suitable for outdoor installation, applied prior to assembly for complete coverage, and shall incorporate louvers in the outer panels to divert air past heated surfaces.
 - 2. The boiler(s), if located on a combustible floor, shall not require a separate combustible floor base.

3. The boiler(s) shall connect both the combustion air and flue products through the back of the unit.
4. The boiler shall have as standard an internal, combustion air filter rated to MERV 8 (>95% arrestance).

M. Boiler Pump – The boiler(s) shall be equipped with a factory-packaged pump system

N. Cold Water Protection System

1. The boiler(s) shall be configured with a cold water protection automatic proportional by-pass system that ensures the boiler will experience inlet temperatures in excess of 120°F in less than 7 minutes to avoid damaging condensation.
2. The cold water protection system shall be configured with two variable-speed pumps that are controlled by a system-matched PID control that injects the correct amount of cold water directly into the boiler loop to maintain the required minimum inlet temperature. The PID controller temperature sensor shall be located in the inlet header of the boiler.

O. PVC Vent Adapter

1. The boiler(s) shall be configured with a PVC vent adapter that allows for the use of PVC vent material with the boiler return water temperature does not exceed 170°F. The PVC vent adapter shall be factory mounted to the boiler flue outlet and the vent termination adapter shall be shipped loose inside of the boiler crating for field installation.
2. The PVC vent adapter shall include a 162°F flue temperature limit mounted to the boiler flue outlet and interlocked into the boiler safety circuit.
3. The boiler shall also have a 200°F manual high limit factory mounted into the boiler outlet header and interlocked into the safety circuit of the boiler.

2.3 BOILER OPERATING CONTROLS

- A. The boiler(s) shall feature a modulating digital controller with selectable outdoor reset mode option, mounted and wired.
- B. System sensor and optional air temperature sensor shall be shipped loose for field installation by installing contractor. Inlet/Outlet sensors are factory-installed.

2.4 DIRECT VENT

- A. The boiler(s) shall meet safety standards for direct vent equipment as noted by the 2006 Uniform Mechanical Code, section 1107.6, and ASHRAE 15-1994, section 8.13.6.

2.5 SOURCE QUALITY CONTROL

- A. The boiler(s) shall be completely assembled, wired, and fire-tested prior to shipment from the factory.
- B. The boiler(s) shall be furnished with the sales order, ASME Manufacturer's Data Report(s), inspection sheet, wiring diagram, rating plate and Installation and Operating Manual.

2.03 ELECTRICAL POWER

- A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.
- B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.
 - 1. House in NEMA 250, Type 1 enclosure.
 - 2. Wiring shall be numbered and color coded to match wiring diagram.
 - 3. Install factory wiring outside of an enclosure in a metal raceway.
 - 4. Field power interface shall be to fused disconnect switch.
 - 5. Provide branch power circuit to each motor and to controls with a disconnect switch or circuit breaker.
 - 6. Provide each motor with overcurrent protection.

2.04 VENTING KITS

- A. Kit: Complete system, ASTM A 959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.
- B. Combustion-Air Intake: Complete system, stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.

2.05 SOURCE QUALITY CONTROL

- A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.
- B. Test and inspect factory-assembled boilers, before shipping, according to 2010 ASME Boiler and Pressure Vessel Code.
- C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting performance of the Work.
 - 1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Examine mechanical spaces for suitable conditions where boilers will be installed.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 BOILER INSTALLATION

- A. Equipment Mounting:
 - 1. Install boilers on cast-in-place concrete equipment base(s).
- B. Install gas-fired boilers according to NFPA 54.
- C. Assemble and install boiler trim.
- D. Install electrical devices furnished with boiler but not specified to be factory mounted.
- E. Install control wiring to field-mounted electrical devices.

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to boiler to allow service and maintenance.
- C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 232116 "Hydronic Piping Specialties."
- E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas-train connection. Provide a reducer if required.
- F. Connect hot-water piping to supply- and return-boiler tapplings with shutoff valve and union or flange at each connection.
- G. Connect steam and condensate piping to supply-, return-, and blowdown-boiler tapplings with shutoff valve and union or flange at each connection.
- H. Install piping from safety relief valves to nearest floor drain.
- I. Install piping from safety valves to drip-pan elbow and to nearest floor drain.
- J. Boiler Venting:
 - 1. Install flue venting kit.
- K. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- L. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
 - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Boiler will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
- F. Performance Tests:
 - 1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
 - 2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
 - 3. Perform field performance tests to determine capacity and efficiency of boilers.
 - a. Test for full capacity.
 - b. Test for boiler efficiency at low fire 20, 40, 60, 80, 100, 80, 60, 40, and 20.
 - 4. Repeat tests until results comply with requirements indicated.
 - 5. Provide analysis equipment required to determine performance.
 - 6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are inadequate.
 - 7. Notify Architect 24 hours minimum in advance of test dates.
 - 8. Document test results in a report and submit to Architect.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 23 52 16

SECTION 23 65 00 - COOLING TOWERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Closed-circuit, forced-draft, counterflow cooling towers.

1.02 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Cooling towers shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, pressure drop, fan performance data, rating curves with selected points indicated, furnished specialties, and accessories.

B. Shop Drawings: Complete set of manufacturer's prints of cooling tower assemblies, control panels, sections and elevations, and unit isolation.

C. Delegated-Design Submittal: For cooling tower support structure indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of support structure.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.04 INFORMATIONAL SUBMITTALS

A. Certificates: For certification required in "Quality Assurance" Article.

B. Seismic Qualification Certificates: For cooling towers, accessories, and components, from manufacturers.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source quality-control reports.

D. Field quality-control reports.

E. Startup service reports.

F. Warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

C. ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. CTI Certification: Cooling tower thermal performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."

E. FMG approval and listing in the latest edition of FMG's "Approval Guide."

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of cooling towers that fail in materials or workmanship within specified warranty period:

1. Fan assembly including fan, drive, and motor.
2. All components of cooling tower.
3. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 CLOSED-CIRCUIT, FORCED-DRAFT, COUNTERFLOW COOLING TOWERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Baltimore Aircoil Company; Models VTO
2. EVAPCO, Inc.

B. Basis-of-Design Products: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Baltimore Aircoil Company

C. Fabricate cooling tower mounting base with reinforcement strong enough to resist cooling tower movement during a seismic event when cooling tower is anchored to field support structure.

D. Casing and Frame:

1. Casing and Frame Material: ASTM A 653/A 653M, G210coating Galvanized steel.
2. Frame Material: Galvanized steel, ASTM A 653/A 653M, G210coating.
3. Fasteners: Stainless steel.
4. Joints and Seams: Sealed watertight.
5. Welded Connections: Continuous and watertight.

E. Collection Basin:

1. Material: Stainless steel.
2. Strainer: Removable stainless-steel strainer with openings smaller than nozzle orifices.
3. Overflow and drain connections.
4. Makeup water connection.

F. Mechanically Operated, Collection Basin Water-Level Control: Manufacturer's standard adjustable, mechanical float assembly and valve.

G. Electric Basin Heater:

1. Stainless-Steel Electric Immersion Heaters: Installed in a threaded coupling on the side of the collection basin.
2. Heater Control Panel: Mounted on the side of each cooling tower cell.

H. Water Distribution Piping: Main header and lateral branch piping designed for even distribution over fill throughout the flow range without the need for balancing valves and for connecting individual, removable, nonclogging spray nozzles.

1. Pipe Material: PVC.
2. Spray Nozzle Material: PVC.
3. Piping Supports: Corrosion-resistant hangers and supports designed to resist movement during operation and shipment.

I. Recirculating Piping: PVC.

J. Spray Pump: Close-coupled, end-suction, single-stage, bronze-fitted centrifugal pump; with suction strainer and flow balancing valve, and mechanical seal suitable for outdoor service.

1. General Requirements for Spray Pump Motor: Comply with NEMA designation and temperature-rating requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment" and not indicated below.
2. Motor Enclosure: Totally enclosed fan cooled (TEFC) with epoxy or polyurethane finish.
3. Energy Efficiency: Comply with ASHRAE/IESNA 90.1.
4. Service Factor: 1.0 1.15.

K. Heat-Exchanger Coils:

1. Tube and Tube Sheet Materials: Stainless-steel tube and sheet.
2. Heat-Exchanger Arrangement: Straight tubes with removable header cover plate on both ends of heat exchanger for straight-through access to each tube; and sloped for complete drainage of fluid by gravity.
3. ASME Compliance: Designed, manufactured, and tested according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, and bearing ASME "U" stamp; and sloped for complete drainage of fluid by gravity.

4. Field Piping Connections: Vent, supply, and return suitable for mating to ASME B16.5, Class 150 flange.
- L. Drift Eliminator:
1. Material: PVC; with maximum flame-spread index of 25 according to ASTM E 84.
 2. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
 3. Configuration: Multipass, designed and tested to reduce water carryover to achieve performance indicated.
- M. Removable Air-Intake Screens: Stainless-steel wire mesh.
- N. Centrifugal Fan: Double-width, double-inlet, forward-curved blades, and statically and dynamically balanced at the factory after assembly.
1. Number of Fans: Each cooling tower cell shall have a single fan or multiple fans connected to a common shaft.
 2. Fan Wheel and Housing Materials: Galvanized steel.
 3. Fan Shaft: Steel, coated to resist corrosion.
 4. Protective Enclosure: Removable, galvanized-steel, wire-mesh screens complying with OSHA regulations.
 5. Fan Shaft Bearings: Self-aligning, grease-lubricated ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F. Bearings designed for an L-10 life of 50,000 hours.
 6. Bearings Grease Fittings: Extended lubrication lines to an easily accessible location.
- O. Belt Drive:
1. Belt-Drive Service Factor: 1.5 based on motor nameplate horsepower.
 2. Sheaves: Fan and motor shafts shall have taper-lock sheaves fabricated from corrosion-resistant materials.
 3. Belt: Multiple V-belt design with a matched set of cogged belts.
 4. Belt: One-piece, multigrooved, solid-back belt.
 5. Belt Material: Oil resistant, nonstatic conducting, and constructed of neoprene polyester cord.
 6. Belt-Drive Guard: Comply with OSHA regulations.
 7. Two-Motor, Single-Fan Drive:
 - a. Two single-speed motors per fan, one sized for full speed and load, and the other sized for 67 percent of full-load speed.
 - b. Belt Drives: Each motor shall have belt drive complying with requirements for belt drives and configured for operation when other motor fails.
 - c. Motor controller and wiring same as two-speed, two-winding motor.
- P. Fan Motor:
1. General Requirements for Fan Motors: Comply with NEMA designation and temperature-rating requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment" and not indicated below.
 2. Motor Enclosure: Totally enclosed fan cooled (TEFC).
 3. Energy Efficiency: Comply with ASHRAE/IESNA 90.1.
 4. Service Factor: 1.15.
 5. Insulation: Class H.

6. Variable-Speed Motors: Inverter-duty rated per NEMA MG-1, Section IV, "Performance Standard Applying to All Machines," Part 31, "Definite-Purpose, Inverter-Fed, Polyphase Motors."
 7. Severe-duty rating with the following features:
 - a. Rotor and stator protected with corrosion-inhibiting epoxy resin.
 - b. Double-shielded, vacuum-degassed bearings lubricated with premium moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F
 - c. Internal heater automatically energized when motor is de-energized.
 8. Motor Base: Adjustable, or other suitable provision for adjusting belt tension.
- Q. Discharge Hoods:
1. Hood Configuration: Straight; totally surrounding drift eliminators and constructed of same material as casing; and having factory-installed access doors.
 2. Discharge Dampers: Positive-closure, automatic, isolation dampers with electric actuators.
 - a. Provide field power and controls to open dampers when pump is energized and close dampers when pump is de-energized.
- R. Vibration Switch: For each fan drive.
1. Enclosure: NEMA 250, Type 4.
 2. Vibration Detection: Sensor with a field-adjustable acceleration sensitivity set point in a range of 0 to 1 g and frequency range of 0 to 3000 cycles per minute. Cooling tower manufacturer shall recommend switch set point for proper operation and protection.
 3. Provide switch for field connection to a BMS and hardwired connection to fan motor electrical circuit.
 4. Switch shall, on sensing excessive vibration, signal an alarm through the BMS and shut down the fan.
- S. Controls: Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC."
- T. Control Package: Factory installed and wired, and functionally tested at factory before shipment.
1. NEMA 250, Type 3R enclosure with removable internally mount back plate.
 2. Control-circuit transformer with primary and secondary side fuses.
 3. Terminal blocks with numbered and color-coded wiring to match wiring diagram. Spare wiring terminal block for connection to external controls or equipment.
 4. Microprocessor-based controller for automatic control of fan and spray pump based on cooling tower leaving-water temperature with control features to improve operating efficiency based on outdoor ambient wet-bulb temperature by using adaptive logic.
 5. Fan motor sequencer for multiple-cell and two-speed applications with automatic lead stage rotation.
 6. Collection basin, electric/electronic level controller complying with requirements in "Electric/Electronic, Collection Basin Water-Level Controller with Solenoid Valve" Paragraph.
 7. Electric basin heaters with temperature control and low-water-level safety switch for each cell, complying with requirements in "Electric Basin Heater" Paragraph.
 8. Vibration switch for each fan, complying with requirement in "Vibration Switch" Paragraph.

9. Controls and wiring for "two-motor, single-fan drives" shall be same as two-speed, two-winding motor.
10. Power and controls to open discharge hood dampers when pump is energized and close dampers when pump is de-energized.
11. Single-point, field-power connection to a fused disconnect switch.
 - a. Branch power circuit to each motor and electric basin heater and to controls with a disconnect switch or circuit breaker.
 - b. NEMA-rated motor controller, hand-off-auto switch, and overcurrent protection for each motor. Provide variable frequency controller with manual bypass and line reactors for each variable-speed motor indicated.
12. Factory-installed wiring outside of enclosures shall be in metal raceway, except make connections to each motor and electric basin heater with liquidtight conduit.
13. Visual indication of status and alarm with momentary test push button for each motor.
14. Audible alarm and silence switch.
15. Visual indication of elapsed run time, graduated in hours for each motor.
16. Cooling tower shall have hardware to enable BMS to remotely monitor and display the following:
 - a. Operational status of each motor.
 - b. Position of dampers.
 - c. Cooling tower leaving-fluid temperature.
 - d. Fan vibration alarm.
 - e. Collection basin high- and low-water-level alarms.

U. Personnel Access Components:

1. Doors: Large enough for personnel to access cooling tower internal components from cooling tower end walls.
2. External Platforms with Handrails: Aluminum, FRP, or galvanized-steel bar grating at cooling tower access doors when cooling towers are elevated and not accessible from grade.
3. Handrail: Aluminum, galvanized steel, or stainless steel complete with kneerail and toeboard at platforms and around top of cooling tower. Comply with 29 CFR 1910.23.
4. Internal Platforms: Aluminum, FRP, or galvanized-steel bar grating.
 - a. Spanning the collection basin from one end of cooling tower to the other and positioned to form a path between the access doors. Platform shall be elevated so that all parts are above the high water level of the collection basin.

2.02 SOURCE QUALITY CONTROL

- A. Verification of Performance: Test and certify cooling tower performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."
- B. Factory pressure test heat exchangers after fabrication and prove to be free of leaks.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install cooling towers on support structure indicated.

COOLING TOWERS

B. Equipment Mounting:

1. Install cooling towers on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
3. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

C. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to cooling towers to allow service and maintenance.

C. Install flexible pipe connectors at pipe connections of cooling towers mounted on vibration isolators.

D. Provide drain piping with valve at cooling tower drain connections and at low points in piping.

E. Domestic Water Piping: Comply with applicable requirements in Section 221116 "Domestic Water Piping." Connect to water-level control with shutoff valve and union, flange, or mechanical coupling at each connection.

F. Supply and Return Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Connect to entering cooling tower connections with shutoff valve, balancing valve, thermometer, plugged tee with pressure gage, flow meter, and drain connection with valve. Connect to leaving cooling tower connection with shutoff valve. Make connections to cooling tower with a union, flange, or mechanical coupling.

G. Equalizer Piping: Piping requirements to match supply and return piping. Connect an equalizer pipe, full size of cooling tower connection, between tower cells. Connect to cooling tower with shutoff valve.

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

- B. Tests and Inspections: Comply with ASME PTC 23, "ASME Performance Test Codes - Code on Atmospheric Water Cooling Equipment CTI ATC 105, "Acceptance Test Code for Water Cooling Towers."
- C. Cooling towers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.04 STARTUP SERVICE

- A. Perform startup service.
- B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.
- C. Obtain performance data from manufacturer.
 - 1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - a. Clean entire unit including basins.
 - b. Verify that accessories are properly installed.
 - c. Verify clearances for airflow and for cooling tower servicing.
 - d. Check for vibration isolation and structural support.
 - e. Lubricate bearings.
 - f. Verify fan rotation for correct direction and for vibration or binding and correct problems.
 - g. Adjust belts to proper alignment and tension.
 - h. Verify proper oil level in gear-drive housing. Fill with oil to proper level.
 - i. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.
 - j. Check vibration switch setting. Verify operation.
 - k. Verify water level in tower basin. Fill to proper startup level. Check makeup water-level control and valve.
 - l. Verify operation of basin heater and control.
 - m. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.
 - n. Replace defective and malfunctioning units.
- D. Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.
- E. Prepare a written startup report that records the results of tests and inspections.

3.05 ADJUSTING

- A. Set and balance water flow to each tower inlet.
- B. Adjust water-level control for proper operating level.

3.06 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain cooling towers.

South El Monte High School Modernization
El Monte Union High School District
South El Monte, California

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END OF SECTION 23 65 00

SECTION 23 70 00 - DUST COLLECTORS

PART 1 – GENERAL

1.1 SUMMARY

- A. Furnish and install, where shown on the plans, a high efficiency filter type dust collector with integral blower sized for design air flow as shown on the schedule.
- B. Dust collector shall be self-cleaning fabric type complete with cotton filters, backward inclined blower, motorized shaker, factory wired controller and external discharge silencer. Manufacturer's literature shall state that dust collector and selected filter spacing is designed for the collection of wood dust.
 - 1. Dust collector shall be airtight, all steel construction with sealed seams and gasketed quick opening doors with 1/4 turn knobs. Housing shall be a minimum of 14-ga. mild steel. Unit shall consist of a filter section, with sloped roof to shed rain and a funnel bottom section without slide gates or doors to allow downflow of dust directly into () 55-gallon drum assembly (ies) furnished by manufacturer. Inlet, with baffle, shall be centered side) for even distribution of dust to the drums. Designs with inlet on narrow side shall not be accepted. Include an explosion relief vent, in the dirty section of the filter housing, per NFPA #664.
- C. Unit to include a multi-pocket filter modules, which is sewn from 8-ounce cotton sateen fabric designed to deliver in excess of 99.5% efficiency by weight on industrial dusts. The filters shall have closed bottom and open top pockets, for the wood waste to remain on the outside surfaces of the filter media. Inside of each pocket shall be a rigid insert separator to prevent collapse of filters and loss of the effective filter area. Flat shaker fingers located at the bottom of the filter module shall prevent adjoining pockets from touching one another and blanking off. The filter pocket spacing shall be wide spacing to permit the collected dust to be shaken off the exterior of the filters and recommended by the manufacturer for the collection of wood dust. Total airflow to filter fabric area (air to cloth ratio) shall not exceed 10 CFM per square foot.
 - 1. Filter designs with open bottom pockets that allow the wood waste to enter the inside of the filter pockets will not be accepted, because of the potential for wood waste to bridge and not shake down
 - 2. Each filter module shall be secured in place by two lever, operated over-center, locking mechanisms to assure a positive seal and allow for easy removal of filters from outside of unit. Designs which require entry into unit (confined space) or require hand tools to remove the filters, for filter maintenance, are not acceptable.
- D. Filters will be cleaned automatically after a fifteen second delay following the shutdown of the blower, by the oscillating action delivered by the motorized eccentric driven shaker assembly, which imparts a rapid and strong vibratory force throughout the entire surface of each individual filter pocket to dislodge the dust. Filters that are suspended from bungee cords or rubber bands are not acceptable. Shaker motor shall be 2-1/3 HP for size 960.
 - 1. Operation of the automatic shaker shall be controlled by a solid state, dual mode timer with adjustable shaker cycle range from 1.8 - 180 seconds. VFD for blower motor, magnetic starter with overload relay for shaker motor and transformer shall be factory wired in a NEMA12 control panel for indoor mounting & wiring by contractor. Outdoor

NEMA 3R safety disconnect switches shipped loose for field mounting & wiring by contractor. Also included shall be a push button station for remote mounting.

- E. The control panel wiring shall be either UL or ETL labeled for compliance with 508A. Control panels not labeled by dust collector manufacturer shall be labeled, in field, by a certified UL or ETL representative, prior to placing equipment in operation.
- F. The integral non-sparking AMCA Type C direct drive blower shall be located on the clean air side of the filters, top mounted at the factory and be of the backward inclined design with a dynamically balanced impeller.
- G. Discharge noise from the blower shall be attenuated by an external field supported duct silencer fabricated with 4.75 lb. density inorganic mineral or glass fiber. This media shall be protected from erosion by the air flow through the use of galvanized perforated metal with aerodynamic leading and trailing edges to insure maximum acoustical insertion loss at minimum static pressure drop. Lining of the fan scroll, instead of an external silencer, shall not be accepted. Include factory installed bird screen on discharge of silencer.
- H. Interior and exterior carbon steel surfaces shall be coated with two part epoxy primer and exterior painted with Sternvent gray two part urethane enamel.
- I. Unit shall be Sternvent Vibraclean as shown on the schedule or American Air Filter Arrestall or Donaldson Unimaster

1.2 WOODWORKING SHOP DUST COLLECTING SYSTEM SPIRAL DUCTWORK

- A. Furnish and install a dust collection system consisting of a dust collector, ductwork, fittings, exhaust hoods and connections to each piece of shop equipment and floor sweeps, all as herein specified or shown on the drawings and required for a complete operating system.
- B. Ductwork shall be constructed of galvanized sheet steel and meet all SMACNA and Industrial Ventilation Manual standards. Conveying velocity shall be 4,000 feet per minute. Ductwork shall be spiral locking seam construction & be in compliance with SMACNA Class 2 requirements for minimum of 15" WG negative (suction). Duct and fitting gauges shall be as follows:

DIAMETER	DUCT GAUGE	FITTING GAUGE
Up to 8"	22	18
9" to 10"	20	16
11" to 14"	18	14
15" to 18"	16	12

- C. Elbows shall have a minimum centerline radius of 1-1/2 times the duct diameter.
- D. Provide dead-end caps within 6" of last branch of all main or sub-mains. Provide cleanouts every 20 feet near each elbow in horizontal sections.
- E. Transitions in mains and sub-mains shall be tapered. Taper 5" long for each 1" change in diameter.
- F. Branches shall enter the main duct laterally (from the side of the duct, not the bottom), at 45 degrees, in the direction of the air flow.

- G. Duct and fitting joints must be airtight. Apply clear silicone caulking one inch inside each large end, completely around the circumference. Work the fitting into the duct until the duct is up to the bead on the fitting. Drill rivet holes using through both layers of duct. Use steel pop rivets with steel pins. Sheet metal screws are not acceptable.
- H. Slide gates shall be full style, with locking screw and provided for balancing the system. Locate gate near connection to each machine and floor sweep. Do not make a connection to any spark-producing machine, such as a grinding wheel.
- I. Locate 6" floor sweep(s), where shown on the plans. If provided with hinged door, for safety reasons, attach chain from door to vertical duct at 5' AFF.
- J. Suction hoods for wood working shop equipment shall be fabricated and customized to fit each machine and be two gauges heavier than the connecting duct. Hoods shall be free of sharp edges or burrs and reinforced to provide stiffness.
- K. Flexible hose from branch ducts to hoods shall be kept at a minimum and be material handling type (not PVC), with wire reinforcement.

1.3 DUST SWITCH SPECIFICATION

- A. Electrically interlock each woodworking machine with the dust collector so that, when a machine is turned on, the dust collector comes on automatically. Include manual override, to permit use of floor sweeps, without having any equipment energized.
 - 1. Provide a push button station with start, E-stop and 2-position selector switch (automatic/manual). Include an adjustable delay timer that will keep the dust collector on for 15-120 seconds after the last machine is switched off, to minimize dust collector cycling and allow the dust in the duct system to be evacuated.
 - 2. All wiring shall be centralized at the circuit breaker panel, for ease of installation and expansion for future machines. The interlock shall not require hard wiring at the machines, modification of the motor starters or special auxiliary contacts.
 - 3. Furnish the Sternvent Dust Switch or an approved equal. UL or ETL labeled.

END OF SECTION 23 70 00

SECTION 23 81 19 - ROOFTOP AIR CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following rooftop air conditioners:

1. Cooling and heating units 6 tons and smaller.

- B. Pitched isolation roof curb.

1.2 SUBMITTALS

- A. Product Data: For each model indicated.

- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Prepare the following by or under the supervision of a qualified professional engineer:

1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases. See Sheet M0.6.
2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
3. Wiring Diagrams: Power, signal, and control wiring.

- C. Field quality-control test reports.

- D. Operation and maintenance data.

- E. Warranties: Special warranties specified in this Section.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

- C. Energy-Efficiency Ratio: Equal to or greater than prescribed by State of California Title 24, Part 6 Addendum AB-970.

- D. Coefficient of Performance: Equal to or greater than prescribed by State of California Title 24, Part 6 Addendum AB-970.
- E. Comply with NFPA 54 for gas-fired furnace section.
- F. ARI Compliance for Units with Capacities Less Than 135,000 Btuh: Rate rooftop air-conditioner capacity according to ARI 210/240, "Unitary Air-Conditioning and Air-Source Heat Pump Equipment."
 - 1. Sound Power Level Ratings: Comply with ARI 270, "Sound Rating of Outdoor Unitary Equipment."
- G. ARI Compliance for Units with Capacities 135,000 Btuh and More: Rate rooftop air-conditioner capacity according to ARI 340/360, "Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment."
 - 1. Sound Power Level Ratings: Comply with ARI 270, "Sound Rating of Outdoor Unitary Equipment."

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of rooftop air conditioners that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 - 2. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.
 - 3. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.
 - 4. Warranty Period for Variable-Speed Fan Motors: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2- PRODUCTS

2.1 ROOFTOP AIR CONDITIONERS 6 TONS AND SMALLER

- A. Manufacturers:
 - 1. Carrier
 - 2. Trane
 - 3. Or Equal
- B. Basis of design is Carrier units. If contractor submits on listed alternates, he shall assume responsibility for any and all necessary structural, electrical, plumbing, architectural and HVAC modifications, and coordinate such.

- C. Description: Factory assembled and tested; designed for exterior installation; consisting of compressor, indoor and outside refrigerant coils, indoor fan and outside coil fan, refrigeration and temperature controls, filters, and dampers.
- D. Casing: Galvanized-steel construction with enamel paint finish, removable panels or access doors with neoprene gaskets for inspection and access to internal parts, minimum 1/2-inch- thick thermal insulation, knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs.
- E. Indoor Fan: Forward curved, centrifugal, belt driven by single-speed motor.
- F. Outside Coil Fan: Propeller type, directly driven by motor.
- G. Refrigerant Coils: Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
- H. Compressor: Hermetic scroll compressor with integral vibration isolators, internal overcurrent and over temperature protection, internal pressure relief, and crankcase heater.
- I. Refrigeration System:
 - 1. Compressor.
 - 2. Outside coil and fan.
 - 3. Indoor coil and fan.
 - 4. Four-way reversing valve and suction line accumulator.
 - 5. Expansion valve with replaceable thermostatic element.
 - 6. Refrigerant dryer.
 - 7. High-pressure switch.
 - 8. Low-pressure switch.
 - 9. Thermostat for coil freeze-up protection during low-ambient temperature operation or loss of air.
 - 10. Low-ambient switch.
 - 11. Brass service valves installed in discharge and liquid lines.
 - 12. Charge of refrigerant.
- J. Filters: 2-inch- thick, fiberglass, pleated, throwaway filters in filter rack. FARR 30/30 Class II. C.S.F.M. No. 3175-0140:006
- K. Heat Exchanger: Aluminized-steel construction for natural-gas-fired burners with the following controls:
 - 1. Redundant single or dual gas valve with manual shutoff.
 - 2. Direct-spark pilot ignition.
 - 3. Electronic flame sensor.
 - 4. Induced-draft blower.
 - 5. Flame rollout switch.
- L. Economizer: Return- and outside-air dampers with neoprene seals, outside-air filter, and hood.
 - 1. Damper Motor: Fully modulating spring return with adjustable minimum position.

2. Control: Electronic-control system uses mixed-air temperature and selects between outside-air and return-air enthalpy to adjust mixing dampers.
 3. Relief Damper: Gravity actuated with bird screen and hood.
- M. Power Connection: Provide for single connection of power to unit with control-circuit transformer.
- N. Unit Controls: In accordance with 230593.
- O. Isolation Curb: Rigid upper and lower steel structure with vibration isolation springs having 1-inch static deflection and vertical and horizontal restraints; with elastomeric waterproof membrane
1. Galvanized steel construction with:
 - a. Wood nailer strips.
 - b. Base plate.
 - c. Acoustical package with two layers of gypsum board attached to upper base member.
 - d. Flexible duct supports including flexible connections at duct drops.
 2. Pitched construction, top level.
 - a. Determine pitch from field conditions.
 3. Match unit base.
 - a. Gaskets between unit and curb.
 4. Seals:
 - a. Continuous neoprene wind and water seals.
 - b. Seal between base and curb.
 - c. Seal between base and bottom of unit.
 5. Manufacturers:
 - a. MicroMetl

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances.
- B. Isolation Curb Support: Install units on isolation curbs and install flexible duct connectors and the following vibration isolation and seismic-control devices. Flexible duct connectors are specified in Section "Duct Accessories."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
 - 1. Gas Piping: Comply with applicable requirements in "Plumbing Piping and Valves." Connect gas piping to burner, full size of gas train inlet, and connect with ground joint union and shutoff valve with sufficient clearance for burner removal and service.
- C. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 - 1. Install ducts to termination in roof curb.
 - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 - 3. Terminate return-air duct through roof structure and insulate space between roof and bottom of unit with 2-inch- thick, acoustic duct liner.
- D. Electrical System Connections: Coordinate with Division 26 Sections for power wiring, switches, and motor controls.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field quality-control tests and inspections and prepare test reports:
 - 1. After installing rooftop air conditioners and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

3.4 ADJUSTING

- A. In accordance with 230593.

END OF SECTION 23 81 19

SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.2 SUBMITTALS

- A. Product Data: For each unit indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- C. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- D. Units shall be designed to operate with HCFC-free refrigerants.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace split-system air-conditioning units that fail in materials and workmanship within five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carrier Air Conditioning; Div. of Carrier Corp.
 2. Mitsubishi Electronics America, Inc.; HVAC Division.
 3. Or Equal.

2.2 EVAPORATOR-FAN UNIT

- A. Concealed Unit Chassis (FC-2): Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
1. Insulation: Faced, glass-fiber duct liner.
 2. Drain Pans: Galvanized steel, with connection for drain; insulated.
- B. Wall-Mounting, Unit Cabinet (FC-1): High-impact Polystyrene with removable panels on front.
1. Discharge Grille: Integrated with evaporator.
 2. Insulation: Faced, glass-fiber.
 3. Drain Pans: under coil with internal trap auxiliary pan under coil header.
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- D. Evaporator Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
- E. Fan Motor: Multispeed.
- F. Filters: Cleanable.
- G. Condensate Pump: See equipment schedule for pump requirement.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER UNIT

- A. Casing steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- B. Compressor: Hermetically sealed scroll type with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor..

1. Refrigerant Charge: R410A.

- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
- D. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.
- E. Fan: Aluminum-propeller type, directly connected to motor.
- F. Motor: Permanently lubricated, with integral thermal-overload protection.
- G. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
- H. Mounting: Cork sandwich between neoprene pad.

2.4 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- B. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- B. Install roof-mounted, compressor-condenser components. See details on plan.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified on drawings. Anchor units to supports with removable, stainless steel fasteners.

3.2 CONNECTIONS

- A. Connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- B. Connect supply and return condenser connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
- C. Install piping adjacent to unit to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 23 81 26

SECTION 26 01 00 – BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

- A. This section supplements all sections of this division and shall apply to all phases of work hereinafter specified, shown on the drawings, or required to provide a complete installation of electrical systems for the Project. The work required under this division is not limited to the electrical specifications and drawings. Refer to all bid documents including Civil, Architectural, Structural, and Mechanical documents which may designate Work to be accomplished. The intent of the Specifications is to provide a complete and operable electrical system, which shall include all documents that are a part of the entire Project Contract.
 - 1. Work included: Furnish all labor, material, tools, equipment, facilities, transportation, skilled supervision necessary for, and incidental to, performing operations in connection with furnishing, delivery, and installation of the work in this division complete as shown or noted on the Drawings and specified herein.
- B. Related Work Specified Elsewhere:
 - 1. Refer to all sections in the general contract conditions, Contract Requirements and Division 1, General Requirements.
- C. Work Installed but Furnished by Others:
 - 1. The electrical work includes the installation or connection of certain materials and equipment furnished by others. Verify installation details. Foundations for apparatus and equipment will be furnished by others unless otherwise noted or detailed.

1.2 GENERAL REQUIREMENTS

- A. Guarantee See General Conditions:
 - 1. Except as may be specified under other Sections in the specification, guarantee equipment furnished under the specifications for a period of one year, except for equipment required to have a longer guarantee period, from date of final completion. Guarantee all work against defective workmanship, material, and improper installation. Upon notification of failure, correct deficiency immediately and without additional cost to the Owner.
 - 2. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner or his service agency as approved. Furnish to the Owner, through the Architect, printed manufacturer's warranties complete with

material included and expiration dates, upon completion of project. Conform to Division 01.

- B. Equipment Safety: All electrical materials and equipment shall be new and shall be listed by Underwriter's Laboratories and bear their label, or listed and certified by a nationally recognized testing authority where UL does not have an approval. Custom made equipment must have complete test data submitted by the manufacturer attesting to its safety.

C. Codes and Regulations:

1. Design, manufacturer, testing and method of installation of all apparatus and materials furnished under the requirements of these specifications shall conform to the latest publications or standard rules of the following:
 - a. Institute of Electrical and Electronic Engineers - IEEE
 - b. National Electrical Manufacturers' Association - NEMA
 - c. Underwriters' Laboratories, Inc. - UL
 - d. National Fire Protection Association - NFPA
 - e. American Society for Testing and Materials - ASTM
 - f. American National Standards Institute - ANSI
 - g. California Electrical Code – CEC, Title 24, Part 3
 - h. California Code of Regulations, Title 8, Subchapter 5
 - i. California Building Code-CBC, Title 24 Parts 1 &2
 - j. State & Municipal Codes in Force in the Specific Project Area
 - k. Occupational Safety & Health Administration – OSHA
 - l. California State Fire Marshal
 - m. California Fire Code- CFC, Title 24 Part 9
 - n. National Electrical Testing Association - NETA
2. The term "Code", when used within the specifications, shall refer to the Publications, Standards, ordinances and codes, listed above. In the case where the codes have different levels of requirements the most stringent rules shall apply.

D. Requirements of Regulatory Agencies:

1. Codes, Permits, and Fees: Where the Contract Documents exceed minimum requirements, the Contract Documents take precedence. Where code conflicts occur, the most stringent shall apply. The most stringent condition shall be as interpreted by the Engineer.
 - a. Comply with all requirements for permits, licenses, fees and Code. Permits, licenses, fees, inspections and arrangements required for the Contractor at his expense shall obtain the Work, unless otherwise specified.
 - b. Comply with the requirements of the applicable utility companies serving the Project. Make all arrangements with the utility companies for proper coordination of the Work.

E. Shop Drawings:

1. See Division 01 for additional requirements.
2. Time Schedules for Submission and Ordering: The Contractor shall prepare, review and coordinate his schedule of submissions carefully, determining the necessary lead time for preparing, submitting, checking, ordering and delivery

of materials and equipment for timely arrival. The Contractor shall be responsible for conformance with the overall construction schedule.

3. Submittals will be checked for general compliance with specifications only. The Contractor shall be responsible for deviations from the drawings or specifications and for errors or omissions of any sort in submittals.

4. Submit a complete list of materials and equipment proposed for the job, including manufacturers names and catalog numbers.

5. Shop drawings shall be submitted in completed groups of materials (i.e., lighting fixtures or switchgear). The Contractor shall add and sign the following paragraph on equipment and materials submitted for review. "It is hereby certified that the (equipment) (material) shown and marked in this submittal is that proposed to be incorporated into the project; is in compliance with the Contract Drawings and specifications and can be installed in the allocated spaces". Failure to add the above written statement for compliance will result in return of submittals without review.

- a. Bind catalog cuts, plate numbers, descriptive bulletins and drawings, 11" x 17" (275 mm x 435 mm) or smaller, in sets with covers neatly showing titles.
- b. The Contractor shall verify dimensions of equipment and be satisfied as to Code compliance for fit prior to submitting shop drawings for approval.
- c. Where current limiting devices are specified, submit technical data to substantiate adequate protection of equipment cascaded downstream. Submittals shall not be reviewed unless supporting calculations and data are submitted therewith.
- d. Include complete catalog information such as construction, ratings, insulation systems, as applicable.
- e. For any material specified to meet UL or trade standards, furnish the manufacturers or vendor's certification that the material furnished for the work does in fact equal or exceed such specifications.
- f. Reference listings to the specifications' Sections and Article to which each is applicable.
- g. Equipment Floor Plans: After approval of material is secured prepare a floor plan of each electrical and communication equipment space, room or yard, drawn to scale at 1/2 inch equals 1 foot and submit for approval in the same manner as for shop drawings. The layout drawings shall be exact scale.

6. Contractor shall prepare coordinated drawings when required by Division 01 or where noted otherwise.

F. Interpretations: The Contractor through the Architect must make Requests for interpretations of drawings and specifications. Any such requests made by equipment manufacturers or suppliers will be referred to the Contractor.

G. Standard of Quality

1. The contract Drawings and Specifications establish the "MINIMUM STANDARD OF QUALITY" each product and/or system must meet to be considered acceptable. Products of other manufactures will be considered if the product

and/or system meet or exceed the "MINIMUM STANDARD OF QUALITY" established by this Contract Document.

- H. Submit comprehensive material list, shop drawings and complete technical data for the following equipment and materials:
1. General Requirements:
 - a. Panelboards.
 - b. Switchboards.
 - c. Conduits
 - d. Conductors, include all selected insulation types.
 - e. Fuses
 - f. Disconnect switches and Starters.
 - g. Pullboxes, manholes and handholes.
 - h. Control devices, standard and special receptacles, switches, outlets and finish device plates.
 - i. Cabinets for signal and telephone system, special terminals and cabinets. Include all cabinet dimensions.
 - j. Fire alarm system.
 - k. Transformers
 - l. Data/telephone cables, devices and terminations (Telecommunications).
 - m. Access Control System.
 - n. Intrusion Detection System.
- I. Utility Service:
1. Contractor shall verify the locations shown on the drawings and shall include extensions of lines to building service from locations which are acceptable to the Owner.
 2. Verify electrical, civil, architectural and structural, dimensional and other requirements with the Owner.
 3. Should any major modifications to the work indicated be necessary to comply with the Owner requirements, notify the Architect.
- J. Record Drawings: Refer to Division 01, Contract Closeout.
- K. Work Responsibilities:
1. The drawings indicate diagrammatically the desired locations or arrangement of conduit runs, outlets, junction boxes and equipment and are to be followed. Execute the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations. The Contractor is responsible for the correct placing of his work. Where conflicts occur in plans and/or specifications, the most stringent application shall apply and shall be part of the base bid.

2. Locations shown on architectural plan or on wall elevations shall take precedence over electrical plan locations, but where a major conflict is evident, notify the Architect.
 3. In the event minor changes in the indicated locations or arrangement are necessary due to developed conditions in the building construction or rearrangement of furnishings or equipment or due to interference with other trades, such changes shall be made without extra cost.
 4. Verify dimensions and the correct location of Owner-Furnished equipment before proceeding with the roughing-in of connections.
 5. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with work carefully check and verify dimensions and sizes with the drawings to see that the furnished equipment will fit into the spaces provided without violation of applicable Codes.
 6. Should any changes to the work indicated on the drawings or described in the specifications be necessary in order to comply with the above requirements, notify the Architect.
 7. Contractor shall be responsible for coordination of coordinated drawings when required by the Architect.
 8. Replace or repair, without additional compensation any work which does not comply with or which is installed in violation of any of these requirements.
- L. Installation General: For special requirements, refer to specific equipment under these requirements.
1. Unless otherwise specified elsewhere in the specifications, do all excavating necessary for the proper installation of the electrical work.
 2. Locations of Openings: Locate chases, shafts and openings required for the installation of the electrical work during framing of the structure. Do any additional cutting and patching required. Cutting or drilling in any structural member is prohibited without approval of the Architect. Furnish all access panels to make all boxes, connections and devices accessible as required by CEC.
 3. Location of Sleeves: Where conduits pass through concrete walls, suspended slabs or metal deck floors, install sleeves of adequate size to permit installation of conduit. Sleeves shall be installed prior to pouring of concrete and shall have ends flush with the wall or extend 2 inches above floor surfaces. Verify locations.
 4. Type of Sleeves: Refer to Section 260500.
 5. Wherever conduit extends through roof, install flashings in accordance with drawings and details.
 6. Contractor shall be responsible for cutting and patching which may be required for the proper installation of the electrical work.
 7. Protect work, materials and equipment cause whatever and provide adequate and proper storage facilities during the progress of the work. Storage outdoors shall be weather protected and shall include space heaters to prevent condensation. Provide for the safety and good condition of all work until final

acceptance of the work. Replace all damaged or defective work, materials and equipment before requesting final acceptance.

8. Conduit and Equipment to be Installed: Clean thoroughly to remove plaster, spattered paint, cement and dirt on both exterior and interior. All underground conduits shall be mandrelled prior to pulling wire.
9. Conduit and Equipment to be Painted: Clean conduit exposed to view in completed structure by removing plaster and dirt. Remove grease, oil and similar material from conduit and equipment by wiping with clean rags and suitable solvents in preparation for paint.
10. Items with Factory Finish: Remove cement, plaster, grease and oil, and leave surfaces, including cracks and corners, clean and polished. Touch up scratched or bare spots to match finish.
11. Site Cleaning: Remove from site all packing cartons, scrap materials and other rubbish on a weekly basis. Vacuum out all cabinets, switchgear and panels and junction boxes prior to pulling any conductors.
12. Electrical equipment and materials exposed to public and in finished areas shall be finish-painted after installation in accordance with the Painting Section. All exposed screw-type fasteners, exterior, or interior in restrooms, shall be vandal-resistant spanner type; include tool.

M. Excavation, Cutting and Patching:

1. Excavating, trenching and backfilling required for the work of this Division in accordance with the applicable requirements of Division 31. Excavating and backfilling connected with electrical work, repaving cuts and providing and maintaining protective measures for the electrical work excavation required by the governing authorities having jurisdiction shall be performed as a part of the work of this Division.
2. Verify openings indicated on the drawings. Provide all cutting, patching and reinforcement of the construction of the building as required to install electrical work.

N. Tests

1. Equipment and systems for which the National Electrical Testing Association (NETA) has an approved or recommended procedure, shall be tested in accordance with that procedure. Test values shall equal values recommended by NETA. Copies of test reports shall be submitted as required under shop drawing submittals.
2. Resistance to ground tests shall be accomplished by a qualified independent testing firm to measure resistance to ground at grounding electrodes. Make tests before slabs or affected areas are poured in order that corrective measures, if required, may be taken. Submit a report showing the results of these measurements. If the resistances exceed values specified elsewhere or NETA test procedure recommendations, perform corrective measures required to reduce resistance to acceptable values.
3. Prior to energizing any motor, measure the service voltage for phase balance and report if unbalance exceeds 1% from mean.

4. Measure the three-phase voltage at no load and at maximum load conditions and submit to the engineer a report showing the results of these measurements.
 5. Upon completion of the work and adjustment of all equipment, conduct an operating test. Conduct the test in the presence of an authorized representative of the Architect. Demonstrate system and equipment to operate in accordance with requirements of the Contract Documents and to be free from electrical and mechanical defects. Provide systems free from short circuits and grounds and show an insulation resistance between phase conductors and ground not less than the requirements of the governing electric code. Test circuits for proper neutral connection.
 6. Complete tests prior to final inspection of project, including corrective work based on the results of the tests.
 7. Perform special tests on systems and equipment as specified herein using personnel qualified to perform such tests.
- O. Protection: Protect finish parts of the materials and equipment against damage during the progress of the work and until final completion and acceptance. Cover materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred. Keep moving parts clean, dry and lubricated.
- P. Cleaning Up:
1. Upon completion of the work and at various time during the progress of the work, remove from the building all surplus materials, rubbish and debris resulting from the work of this Division.
 2. Thoroughly clean switchgear including busses, apparatus, exposed conduit, metal work including the exterior and interior, and accessories for the work of this Division, of cement, plaster and other deleterious materials; remove grease and oil spots with cleaning solvent; carefully wipe surfaces and scrape cracks and corners clean.
 3. Thoroughly polish chromium or plated work. Remove dirt and stains from lighting fixtures.
 4. Leave the entire installation in a clean condition.
- Q. Completion:
1. The work will not be reviewed for final acceptance until operating and maintenance data, manufacturer's literature, panel directories and nameplates specified herein have been approved and properly posted or installed and final cleaning of equipment and premises has been completed.
 2. When the installation is complete and adjustments have been made, operate the system for a period of one week, during which time demonstrate that systems are completed and operating in conformance with the specifications.
- R. Operating and Maintenance Data: Submit complete and at one time, prior to acceptance of the installation, 4 copies of manufacturer's instructions for operation and maintenance of electrical equipment, including replacement parts lists. As specified in Division 01

- S. Inspection and Acceptance Procedures: The Architect will submit observation reports periodically during the construction phase detailing Contract deficiencies. The Contractor is responsible for making corrections immediately. Notice of Completion of the project will not be made until all items have been corrected.
- T. Final Completion of Electrical Systems:
1. Prior to Final Completion of operating electrical systems, the Contractor shall:
 - a. Provide materials of the type and quality specified and as necessary for proper operation, tested and ready for use.
 - b. Deliver to the Architect, the Record Documents per 1.3 of this section.
 - c. Furnish the required Operating and Maintenance Data/Manuals.
 - d. Clean up of the project pertaining to this Division of the work.
 - e. After installation has been completed and adjustments made, operate the system for a period of one week, during which time, demonstrate to the Architect that systems are complete and operating in conformance with Contract Documents.
 - f. Conduct tests required and as specified in this Division and submit test reports and corrective actions taken.
 - g. Submission of warranties and guarantees.
 2. Final Completion of Work Shall be Contingent On:
 - a. Contractor replacing defective materials and workmanship.
 - b. Upon completion of work and adjustments made, Contractor shall conduct an operating test for each system for approval at such time as Architect directs. Conduct test in presence of authorized representative of Architect and demonstrate that systems and equipment do operate in accordance with requirements of the Contract Documents and are free from electrical and mechanical defects.
 - c. Contractor shall provide the necessary training programs and instructions to the Owner's representative. Number of hours shall be a minimum of four (4) hours for each system or days as required under separate Sections of these Specifications. Complete operation and maintenance manuals shall be provided at least two (2) weeks prior to training.
 - d. Submit copies of manufacturer's instructions and maintenance of electrical equipment including replacement parts lists. Each set shall include one set of shop drawings of equipment installed.
- U. Submittals for Change Orders: When changes are made during the construction phase, deletions and additions shall be presented in a manner that will indicate the cost of each item of material and corresponding labor. Markup shall be then added in accordance with the requirements of the General Conditions as modified by the Supplementary Conditions.
- V. The Contractor at a time convenient to the Owner shall provide instruction to the Owner's operating personnel in the proper operation and maintenance of all equipment and systems. The instructors shall have received factory training and shall be thoroughly familiar with the equipment installed. The operating personnel shall receive the number of days instruction as indicated in other sections.

1.3 PROJECT RECORD DOCUMENTS

- A. Record Drawings: CAD: Use a computer aided drafting (CAD) system in the preparation of record drawings for this Project. Acceptable CAD systems shall be capable of producing files in AutoCAD Version 2019 compatible DWG or DXF format. Owner's consultant will furnish CAD backgrounds for use by the Contractor after construction is 85% complete except where prohibited by Contract.
- B. At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies, a complete separate, clean, undamaged set of the latest stamped, actioned submittals. As work progresses, maintain records of "as installed" conditions on this set in suitable ink or chemical fluid. Update the set daily. After successful completion of Project Site testing specified herein, and after completion of Punch List corrections, copy all records of "as installed" conditions on to originals.
- C. Quantity:
 - 1. Review sets: As for Shop and Field Drawings.
 - 2. Record set: Three (3) blackline.
- D. Format: Record Drawings:
 - 1. Disk copy of Record Drawings - 1 copy of each drawing file in format noted above, CD-ROM.
- E. Content: All drawings required under "Field and Shop Drawings". Show "as installed" condition. Where room designations according to Project permanent signage differ from construction designations in the Contract Documents, show both designations.
- F. Warranty Certificates: Comply with Division 01.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 26 01 00

SECTION 26 01 11 - CONDUIT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Rigid metal conduit and fittings.
- B. Intermediate metal conduit and fittings.
- C. Electrical metallic tubing and fittings.
- D. Flexible metal conduit and fittings.
- E. Non-metallic conduit and fittings.
- F. Intermediate metal conduit and fittings.

1.2 REFERENCES

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- B. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
- C. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- D. CEC – California Electrical Code.
- E. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally-Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.
- F. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- G. FS-WW-C-581 - Specification for Galvanized Rigid Conduit.
- H. FS-WW-C-566 - Specification for Flexible Metal Conduit.
- I. FS-WC-1094A - Electrical Non-Metallic Conduit.
- J. NEMA-TC-2 - Electrical Plastic Tubing and Conduit.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect, and handle Products to site under provisions of Section 26 01 00.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

1.4 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS

- A. Minimum Size: 3/4 inch for above ground and 1 inch minimum for underground installations unless otherwise specified.
- B. Conduit Installation Schedule:
 - 1. Underground conduit more than five feet from foundation wall shall be concrete encased non-metallic PVC Schedule 40 heavy wall rigid conduit.
 - 2. Underground conduit under four-inch minimum concrete floor slab shall be PVC Schedule 40 heavy wall rigid conduit.
 - 3. All telecommunication conduit in conduit shall use rigid type, no flexible conduit is permitted.
 - 4. Conduit installed in concrete or masonry, exposed outdoor locations, damp locations, hazardous locations, or where subject to mechanical injury shall be galvanized rigid steel or intermediate metal conduit.
 - 5. Conduit installed in concealed dry interior locations such as walls or ceiling of the building shall be electrical metallic tubing or flexible type.
 - 6. Conduit installed in exposed dry interior locations above eight feet shall be electrical metallic tubing.
 - 7. Conduit installed to supply power to all mechanical equipment and rotating electric equipment shall be waterproof flexible steel conduit. Conduit shall be 12" minimum in length for 2" conduit and smaller; 18" minimum length for conduit larger than 2". Conduit shall be 36" maximum in length.
 - 8. Flexible steel conduit shall be used for power receptacle and lighting fixture connections only.

2.2 METAL CONDUIT

- A. Rigid Steel Conduit: Galvanized rigid steel; ANSI C80.1: Standard weight that is not dipped, galvanized, electrogalvanized or sherardized, both inside and out, with threaded connections and couplings is not permitted.

2.3 PVC COATED METAL CONDUIT

- A. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil thick, and internal galvanized surface.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; threaded type, material to match conduit.

2.4 FLEXIBLE METAL CONDUIT

- A. Description: Conduit - Manufactured from single strap standard weight steel, galvanized on all four sides prior to conduit fabrication. Lightweight flexible steel conduit and aluminum flexible conduit are not acceptable. Include ground conductor in all runs.
- B. Fittings: ANSI/NEMA FB 1; Die-cast fittings of the type that screw into the inside of the conduit with threaded edges at 90 degrees to the fitting body.

2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Description: Interlocked steel construction with moisture and oil-proof PVC jacket.
- B. Fittings: ANSI/NEMA FB 1: liquid tight; integral insulated throat; provisions for ground continuity.

2.6 ELECTRICAL METALLIC TUBING (EMT)

- A. Description: ANSI C80.3; galvanized tubing;
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel raintight, compression, steel locking ring type with integral insulated throat.

2.7 NONMETALLIC CONDUIT

- A. Description: NEMA TC 2; Federal Spec. WC-1094A; Schedule 40 PVC.
- B. Fittings and Conduit Bodies: NEMA TC 3 to match conduit.

2.8 INNERDUCT, MULTI-CHAMBER

- A. Drawing and spec reference: Fiberoptic, Innerduct.
- B. Construction:
 - 1. Multi-Chamber or Single-Chamber 1" Innerduct shall be installed within Conduit per manufacturer's recommendation, and as described elsewhere herein.
 - 2. Shall provide independent interior chambers each with a capacity equal to a trade size conduit referenced above.
- C. Approvals:
 - 1. ASTM D2239 (1985) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
- D. Acceptable, subject to the above:
 - 1. Aeroquip FODuct System (800) 445-2192: (Design Basis) Provide in combinations to meet scheduled requirement.
 - a. 3ID1 - Provide on e(1) FoDuct PE5004 3 chamber innerduct in one-half of a 4" diameter conduit.
 - b. 2ID1.25 - Provide one (1) FODUCT PE5007 2 chamber innerduct in one-half of a 4" diameter conduit.
 - 2. North Supply Multi-Guard Multi-Cell Conduit.
 - 3. Approved equal by Tamaqua.
- E. Acceptable - Independent InnerDuct runs in overall rigid conduit - Multiple runs of single chamber inner duct may be provided in lieu of single, multiple chamber innerduct provided above. Contractor bears burden of selected innerduct quantity to provide an exact match of cross-sectional area of each chamber of multi-chamber assembly and to resize overall conduit to accommodate this use.
 - 1. Allied.
 - 2. Approved equal.

2.9 CONDUIT SUPPORTS

- A. Conduit clamps, straps, and supports: Steel or malleable iron, two-hole straps.

PART 3 - EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT AND SUPPORT

- A. The size of the conduits for the various circuits shall be as indicated on the drawings and as required by Code for the size and number of conductors to be pulled therein. Where fill is not

shown on drawings, size conduit for conductor type installed or for Type THW conductors, whichever is larger; 3/4-inch minimum size. Open ends shall be capped with approved manufactured conduit seals as soon as installed and kept capped until ready to pull in conductors. Where running thread connections are necessary, only approved manufactured conduit unions shall be used. Do not embed aluminum conduit in concrete or masonry construction, nor electrical metallic tubing in slabs on grade. Do not install any conduit in any concrete slab.

- B. Arrange conduit to maintain headroom and present a neat appearance.
- C. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
- D. Maintain minimum 6-inch clearance between conduit and piping. Maintain 12-inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.
- E. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers. Maintain 12" distance minimum between main conduit runners and ceiling system grid.
- F. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
- G. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.
- H. Support conduits 1 inch and larger with pipe clamps either suspended from structural slabs with a rod with adjustable pipe ring, or mounted on wall from channel supports. Attach to concrete by expansion anchors. Powder actuated fastening devices are not permitted. Where two or more conduits 1-1/2 inch and larger or where 3 or more 3/4 inch conduits are suspended from ceiling, use trapeze type hanger from rods.
- I. Firmly support and fasten conduit in place. Support rigid metal conduit and electrical cabinet and fitting. Support flexible metal conduit at maximum intervals of 4 feet and within 12 inch of every outlet box and fitting except for lengths of not over 2 feet at connections where flexibility is required.
- J. Secure exposed conduit runs of concrete, plaster or other construction in place with cast conduit clamps affixed with expansion anchors or galvanized machine or lag screws.
- K. Do not strap or fasten rigid or electrical metallic tubing to mechanical equipment or to equipment subject to vibration or mounted on shock absorbing bases, including sprinkler or pneumatic pipe or tubing.
- L. Provide independent support for conduit rising from floor for motor connection if over 18 inches above floor. Do not attach to motors, ductwork or mechanical equipment.
- M. Conduits 1 inch and smaller which are installed above suspended ceilings shall not be secured to ceiling support wires. Support electrical, communication conduits and fixtures independent of ceiling suspension systems.

- N. Exposed conduits to view shall be installed parallel to and perpendicular to the building structure.
- O. Tag empty conduits at each accessible end with a permanent tag identifying the purpose of the conduit and the location of the other end. In wet, corrosive outdoor or underground locations, use brass, bronze, or copper 16 gage tags or lead tags secured to conduit ends with #16 or larger galvanized wire. Inscribe on the tags with steel punch dies clear and complete identifying information.
- P. Bends:
 - 1. Raceways for Sound System, Telephone System, LAN, and Video System cables shall be designed for the installation of Fiber Optic cable.
 - 2. All bends or elbows shall have a minimum radius as follows:

Conduit Size (inches)	Min. Radius (inches)
3/4	12
1	12
1-1/4	18
1-1/2	
2	24
2-1/2	24
Conduit Size (inches)	Min. Radius (inches)
3	36
3-1/2	36
4	48
5	48
6	48

- 3.2 Use factory ells at conduit bends 1-1/4" and larger. Alternative method: Use of precision conduit bending machine equivalent to Greenlee 'One Shot' or 'Smart Bender'.
 - A. Boxes where the cable changes direction shall be large enough to allow cables in the box to have a 12" minimum radius.
 - B. Make bends and offsets so the inside diameter is not effectively reduced. Make bends in parallel or banked runs from the same center line so that the bends are parallel.
- 3.3 CONDUIT INSTALLATION
 - A. Cut conduit square using a saw or pipe cutter; de-burr cut ends.
 - B. Bring conduit to the shoulder of fittings and couplings and fasten securely.
 - C. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations.

- D. Install no more than the equivalent of three 90-degree bends between boxes. Keep bends and offsets in conduit runs to an absolute minimum. For the serving utilities, make large radius bends to meet their requirements. Replace deformed, flattened or kinked conduit.
- E. Use conduit bodies to make sharp changes in direction, as around beams.
- F. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch size.
- G. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- H. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
- I. Provide No. 12 AWG insulated conductor or suitable pull string or rope in empty conduit, except sleeves and nipples.
- J. Install expansion-deflection joints where conduit crosses building expansion or seismic joints and between building and walkway covers.
- K. Where conduit penetrates fire-rated walls and floors, provide mechanical firestop fittings with UL listed fire rating equal to wall or floor rating.
- L. Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket.
- M. Do not install conduit in slabs above grade.
- N. PVC conduit shall not be used in any locations above grade.
- O. From each panel or cabinet which is flush mounted in wall, stub from top of the panel a minimum of 5-3/4 inch conduits to the nearest accessible ceiling space or other accessible location and cap for future use unless noted otherwise on the drawings.
- P. Flexible steel conduit is permitted in concealed dry interior locations at power and lighting fixture connections only.
- Q. Seal conduit from exterior outlets at first interior junction to prevent moisture from entering the building through the conduit.
- R. Use insulating fittings on conduits where entering pullboxes, junction boxes, outlet boxes, cabinets and similar enclosures, and for signal and telephone conduits terminated in cabinets or backboards.
- S. Conduit risers and ell's through concrete shall be PVC wrapped Rigid Galvanized Steel minimum.
- T. Conduit installed in corrosive atmospheres (pool mechanical, tank or chlorine rooms, etc.) shall be IMC conduit minimum and shall comply with CEC 358.10(B).

3.4 UNDERGROUND DUCTBANK INSTALLATION

- A. Install top of duct bank minimum 24 inches below finished grade. Adjust depth to avoid interference with gravity flow systems of any kind. Maintain minimum 12 inch clearance between duct bank and any gravity flow system.
- B. Duct lines shall have a continuous slope downward toward manholes and away from buildings with a pitch of not less than 4 inches in 100 feet. 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, except that manufactured bends may be used at ends of short runs of 100 feet or less, and then only at or close to the end of run.
- C. Terminate conduit in end bell at manhole and pullbox entries.
- D. Use suitable separators and chairs installed not greater than 4 feet on centers. Band conduit together with suitable banding devices. Securely anchor conduit to prevent movement during concrete or slurry placement.
- E. Provide minimum 3 inch concrete cover at bottom, top, and sides of duct bank. Refer to Trenching section for additional information.
- F. Provide two No. 4 steel reinforcing bars in top of bank under paved areas.
- G. Encase non-metallic primary and secondary feeders, telephone, fire alarm communications and data conduit installed underground 2 inches or larger in a concrete or 2 sack slurry duct bank unless noted otherwise in the Contract Documents. Space the external surfaces of conduit within a bank a minimum of 3 inches apart except that sound, telephone, data and intercommunication circuits contained within non-metallic conduit shall have a minimum separation of 12 inches from any light or power circuits that parallel them within a bank. Use appropriate manufactured plastic spacers to insure the minimum required concrete or 2-sack slurry coverage. All concrete or slurry duct power banks shall contain a yellow warning strip 12" above ductbank. Refer to Division 02.
- H. Numbers and sizes of ducts shall be as indicated. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Manufactured steel 90-degree duct bends shall be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 18 inches for ducts of less than 3-inch diameter, and 36 inches for ducts 3 inches in diameter 48 inches for ducts or greater in diameter unless noted otherwise in the Contract Documents. Long sweep bends having a minimum radius of 25 feet shall be used for a change of direction of more than 5 degrees, horizontally or vertically. Both curved and straight sections shall be used to form long sweep bends as required, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes, pullboxes or handholes. Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In lieu of markers, a 5-mil brightly colored plastic tape not less than 3 inches in width and suitably inscribed at not more than 10 feet on centers with a continuous metallic backing and a corrosion resistant 1-mil metallic foil core to permit easy location of the duct line, shall be placed approximately 12 inches below finished grade levels of such lines.

- I. Ducts shall be kept clean of concrete or slurry, dirt or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. After a duct line is completed, a standard flexible mandrel shall be used for cleaning followed by a brush with stiff bristles. Mandrels shall be at least 12 inches long and have diameters 1/4 inch less than the inside diameter of the duct being cleaned. Pneumatic rodding may be used to draw in lead wires. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

END OF SECTION 26 01 11

SECTION 26 01 30 - BOXES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Wall and ceiling outlet boxes.
- B. Pull and junction boxes.

1.2 REFERENCES

- A. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- B. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. C.E.C.- California Electrical Code.

1.3 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 01.
- B. Accurately record actual locations and mounting heights of outlet, pull and junction boxes.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of C.E.C.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.5 PROJECT CONDITIONS

- A. Verify field measurements are as shown on drawings.
- B. Electrical boxes are shown on drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose.
- C. Exact location of all outlet boxes shall be as indicated on architectural elevations. Outlets not shown shall be coordinated with the Architect prior to rough-in. Any outlets not coordinated, which

are mounted in locations not accepted by the Architect, shall be relocated at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, 4" x 4" x 1-1/2" minimum size (unless noted otherwise).
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2-inch male fixture studs where required.
 - 2. Extra deep 5S outlet boxes (4-11/16" x 4-11/16" x 2-1/2") shall be used at data and A/V outlets. Where 5S outlet boxes require installation of 1-1/2" conduits, the outlet box shall be increased to 3-1/4" deep equal to RACO #260.
- B. Cast Boxes: NEMA FB 1, Type FD, cast ferrous alloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.

2.2 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1; galvanized steel.
- B. Surface-Mounted Cast Metal Box: NEMA 250; Type 4, flat-flanged, surface-mounted junction box.
 - 1. Material: Galvanized cast iron.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless-steel cover screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements.
- B. Install electrical box to maintain headroom and to present a neat appearance.
- C. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- D. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- E. Install boxes to preserve fire resistance rating of partitions and other elements, as allowed by NFPA.

- F. Align adjacent wall-mounted outlet boxes for switches, thermostats and similar devices with each other.
- G. Use flush mounting outlet boxes in finished area.
- H. Do not install flush mounting boxes back-to-back in walls; provide minimum 6-inch separation. Provide minimum 24 inches separation in acoustic rated walls and fire-rated walls.
- I. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness. Outlet boxes on metal studs shall be attached to metal hangers, tack welded or bolted to studs; on wood studs' attachment shall be with wood screws, nails are not acceptable.
- J. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- K. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- L. Use adjustable steel channel fasteners for hung ceiling outlet box.
- M. Do not fasten boxes to ceiling support wires.
- N. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.
- O. Use gang box where more than one device is mounted together. Do not use sectional box.
- P. Use gang box with plaster ring for single device outlets.
- Q. Use cast outlet box in exterior locations exposed to the weather and wet locations.
- R. Large Pull Boxes: Boxes larger than 100 cubic inches in volume or 12 inches in any dimension.
 - 1. Interior Dry Locations: Use hinged enclosure under provisions of Section 26 01 60.
 - 2. Other Locations: Use surface-mounted cast metal box.
- S. Open knockouts in outlet boxes only where required for inserting conduit.
- T. All boxes and panels/cabinets shall be covered with cardboard and duct tape to keep plaster and dirt from entering box or panels. All boxes shall be vacuum cleaned prior to pulling wires.
- U. All pull and junction boxes shall be clearly and permanently marked indicating the panel and circuit numbers of conductors within the box.
- V. Coordinate with architectural drawings for tackable wall covers and provide special extension rings for flush finish fit to comply with CEC 370.20.

3.2 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes. The Contractor shall be responsible for cut-outs in tile or counter splashes where outlet boxes are to be installed.
- B. Position outlet boxes to locate luminaires as shown on reflected ceiling plan.

3.3 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused box openings.

END OF SECTION 26 01 30

SECTION 26 01 60 - CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Hinged cover enclosures.
- B. Cabinets.
- C. Terminal blocks and accessories.

1.2 REFERENCES

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. ANSI/NEMA ICS 1 - Industrial Control and Systems.
- C. ANSI/NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.
- D. ANSI/NEMA ICS 6 - Enclosures for Industrial Control Equipment and Systems.

1.3 SUBMITTALS

- A. Submit product data under provisions of Division 01.
- B. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing and construction diagram as described in ANSI/NEMA ICS 1.

PART 2 - PRODUCTS

2.1 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250; Type 1, 3R, steel.
- B. Finish: Manufacturer's standard enamel finish.
- C. Covers: Continuous hinge, held closed by flush latch operable by key.
- D. Panel for Mounting Terminal Blocks or Electrical Components: 14 gage steel, white enamel finish.

2.2 CABINETS

- A. Cabinet Boxes: Galvanized steel with removable endwalls. Provide 3/4-inch-thick plywood backboard painted matte white, for mounting terminal blocks.
- B. Cabinet Fronts: Steel, flush surface type with concealed trim clamps, screw cover front, concealed hinge and flush lock keyed to match branch circuit panelboard; finish as approved by Architect.

2.3 TERMINAL BLOCKS AND ACCESSORIES

- A. Terminal Blocks: ANSI/NEMA ICS 4; UL listed.
- B. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.
- C. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 300 volts.

2.4 FABRICATION

- A. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.
- B. Provide conduit hubs knockouts on enclosures.
- C. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cabinets and enclosures plumb; anchor securely to wall and structural supports at each corner, minimum.
- B. Provide accessory feet for free-standing equipment enclosures.
- C. Install trim plumb.
- D. Provide nameplate per Section 26 01 95.
- E. Ground and bond per Section 26 01 70.

END OF SECTION 26 01 60

SECTION 26 04 40 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Disconnect switches.
- B. Fuses.
- C. Enclosures.

1.2 REFERENCES

- A. ANSI/UL 198C - High-Intensity Capacity Fuses; Current Limiting Types.
- B. ANSI/UL 198E - Class R Fuses.
- C. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).
- D. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.
- E. NEMA KS 1 - Enclosed Switches.
- F. C.E.C. California Electrical Code.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - DISCONNECT SWITCHES

- A. Square D
- B. Eaton Cutler-Hammer.
- C. GE.

2.2 DISCONNECT SWITCHES

- A. Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: FS W-F- 870.

- B. Enclosures: NEMA KS 1; Type 1, for interior dry locations; Type 3R for exterior or wet locations. Furnish 1 padlock and two keys for each disconnect, Master 611 or M-20.
- C. Switch Ratings: Number of poles, voltage, current and horsepower rating as required for particular installation.

2.3 ACCEPTABLE MANUFACTURERS - FUSES

- A. Littelfuse.
- B. Gould Shawmut.
- C. Bussman.

2.4 FUSES

- A. Fuses 600 Amperes and Less: ANSI/UL 198E, Class RK1; current limiting, one-time fuse, 250 volt.
- B. Interrupting Rating: 200,000 rms amperes.
- C. Size fuses based on motor nameplate rating.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches where indicated on Drawings.
- B. Install fuses in fusible disconnect switches, otherwise required by Code.
- C. Properly align switches and support independent of the connecting raceway.

END OF SECTION 26 04 40

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

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. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common electrical installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria is not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building wire and cable.
- B. Wiring connectors and connections.

1.2 REFERENCES

- A. ANSI/NFPA 70 – California Electrical Code.
- B. C.E.C. – California Electrical Code.
- C. InterNational Electrical Testing Association.
- D. OSHA, Definition B, 29 CFR 1910.7.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of C.E.C.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.5 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required meeting Project Conditions.
- C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.6 COORDINATION

- A. Determine required separation between cable and other work.
- B. Determine cable routing to avoid interference with other work.

PART 2 - PRODUCTS

2.1 BUILDING WIRE AND CABLE

- A. Description: Single conductor insulated wire, new, manufactured not more than 6 months prior to installation, with size, type of insulation, voltage rating and manufacturer's name permanently marked on outer covering at regular intervals.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRING METHOD

- A. Type THHN/THWN insulation for dry interior locations, in raceway.
- B. Type THWN for exterior or wet locations, in raceway.

3.4 INSTALLATION

- A. Provide conductors continuous from outlet to outlet and splice only at outlet or junction boxes.
- B. Circuit all feeders and branch circuits as shown on the drawings. Suggested deviation from the plans must be provided by the Architect.

- C. Install products in accordance with manufacturers instructions.
- D. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- E. Use stranded conductors for control circuits.
- F. Use conductor not smaller than 12 AWG for power and lighting circuits.
- G. Use conductor not smaller than 16 AWG for control circuits.
- H. Low voltage control wiring shall be No. 18 AWG minimum, insulated cable for each conductor. Voltage rating of cable shall be suitable for either Class I or Class II, remote control or signal circuit, as determined by the code and the actual installation.
- I. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (450-m).
- J. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet (600-m).
- K. Install all conductors in a single raceway at one time, insuring that conductors do not cross one another while being pulled into raceway. Leave sufficient cable at all fittings or boxes and prevent conductor kinks. Keep all conductors within the allowable tension and exceeding the minimum-bending radius.
- L. Use suitable wire pulling lubricant for building wire 4 AWG and larger. Lubricants for wire pulling shall conform to UL requirements for the insulation and raceway material.
- M. Provide conductor supports as required by Code and recommended by the cable manufacturer. Where required, provide cable supports in vertical conduits similar to OZ Gedney Type CMT and provide the lower end of conduit with OZ Gedney Type KVF ventilators.
- N. No splicing or joints will be permitted in either feeder or branch circuits except at outlet or accessible junction boxes.
- O. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- P. Clean conductor surfaces before installing lugs and connectors.
- Q. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise. Keep splices in underground junction boxes, handholes, and manholes to an absolute minimum. Where splices are necessary, use resin pressure splices and resin splicing kits manufactured by the 3M Company to totally encapsulate the splice. Arrange the splicing kit to minimize the effects of moisture.
- R. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- S. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

- T. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- U. Provide all power and control conductors, that terminate on equipment or terminal strips, with solderless lugs or tork and flanged tongue terminals. Provide T & B "Sta-kon" tongue terminal. This type conductor termination is not required when the equipment is provided with solderless connectors.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Division 26.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.
- C. Conductor Identification: All branch circuit conductors (No. 10 AWG and smaller) throughout the project shall be provided with color-coded insulation as follows:

208Y/120V	Phase	480Y/277
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

- D. Conductors No. 8 and larger shall be black with bands of colored nonaging, plastic tape to color code the conductors, utilizing the same scheme as for branch circuits. The bands shall occur within each enclosure where a tap, splice or termination is made.
- E. Color code all control wire insulation and label each termination.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

- a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- D. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
 - 5. Grounding for sensitive electronic equipment.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS and CEC Article 250.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with UL 467 for grounding and bonding materials and equipment.
- D. Comply with the California Electrical Code (CEC).

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
 - 5. Bonding Conductor: No. 4 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
 2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 4/0 AWG minimum.
 1. Bury at least 24 inches (600 mm) below grade.
 2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
- E. Conductor Terminations and Connections:
 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.

3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements and CEC Article 250.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits sized per C.E.C. Table 250-122.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by CEC:
 1. Feeders and branch circuits.
 2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Armored and metal-clad cable runs.
 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater: Install a separate insulated equipment grounding conductor to each electric water heater. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- G. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in $\frac{3}{4}$ " (19mm) raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- H. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

- C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.
 - 1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column and where indicated on the drawings.

1. Install tinned-copper conductor not less than No. 4/0 AWG for ground ring and for taps to building steel.
 2. Bury ground ring (where indicated) not less than 24 inches (600 mm) from building foundation.
- J. UFER Ground (Concrete-Encased Grounding Electrode): Fabricate according to CEC, using a minimum of 40 feet (12 meters) of bare copper conductor not smaller than No. 4/0 AWG.
1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a 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 the following field tests and inspections and prepare test reports:
- C. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- D. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.
 5. Substations and Pad-Mounted Equipment: 5 ohms.

6. Manhole Grounds: 10 ohms.
- E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Division 26 Section "Vibration And Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with California Electrical Code (CEC).

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.

- c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 6. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.
- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 - 3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 - 4. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 - 5. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by CEC. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in CEC.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete or Cast-in-Place Concrete (Limited Applications)" as applicable.
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturers written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 32 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Nameplates.
- B. Wire and cable markers.

1.2 SUBMITTALS

- A. Submit shop drawings under provisions of Division 01.
- B. Include schedule for nameplates and tape labels.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Nameplates: Engraved three-layer laminated plastic, white letters on a black background.
- B. Wire and Cable Markers: Cloth markers, split sleeve or tubing type.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates and tape labels parallel to equipment lines.
- C. Secure nameplates to equipment fronts using screws, or rivets. Secure nameplate to inside face of recessed panelboard doors in finished locations.
- D. Embossed tape will not be permitted for any application.

3.2 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with panel and branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams equipment manufacturer's shop drawings for control wiring.

3.3 NAMEPLATE ENGRAVING

- A. Provide nameplates to identify all circuits in the service distribution and power distribution panelboards; branch circuit panelboards; separately mounted starting switches; disconnecting switches; motor control push-button stations; selector switches; terminal cabinets; telephone cabinets, etc. Clearly identify on the nameplate the equipment such as "Air Handling Unit AH-1" and "Hot Water Cir. Pump P-1" in lieu of abbreviated plan references such as "AH-1" or "P-1".
- B. Provide nameplates of minimum letter height as scheduled below.
- C. Panelboards and Switchboards: 1/4 inch; identify equipment designation, voltage rating, and source.
- D. Individual Circuit Breakers In Panelboards and Switchboards: 1/8 inch; identify circuit and load served, including location.
- E. Individual Circuit Breakers, Enclosed Switches and Motor Starters: 1/8 inch; identify voltage rating, ampere rating and load served including location.
- F. HVAC and Plumbing Control Equipment: 1/8 inch; identify equipment designation and equipment served including location.
- G. Communication Terminal Cabinets: 1/4 inch; identify cabinet designation and type of system.

END OF SECTION 26 05 32

SECTION 26 05 48 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Spring isolators.
 - 3. Restrained spring isolators.
 - 4. Channel support systems.
 - 5. Restraint cables.
 - 6. Hanger rod stiffeners.
 - 7. Anchorage bushings and washers.
- B. Related Sections include the following:
 - 1. Division 26 Section "Hangers And Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.
- D. CEC: California Electrical Code.
- E. CBC: California Building Code.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:

1. Electrical equipment shall be seismically anchored to conform to C.C.R. Title 24, 2019 CBC Section 1616A.1.18 through 1616A.1.26 and ASCE 7-10 Chapter 13, 26 and 30, Anchorage details not shown on the approved plans or otherwise approved by DSA are subject to field approval by the Architect and/or Structural Engineer of record and field approval by DSA. All conduits shall be supported and braced in accordance with SMACNA Guidelines, the CEC and as approved by DSA.

1.5 SUBMITTALS

- A. Product Data: For the following:
 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
- B. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- C. Welding certificates.
- D. Qualification Data: For Testing Agency.
- E. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the CBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPM number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- E. Comply with CEC.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
- D. Pads : Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment. Refer to drawing details for locations.
 - 1. Resilient Material: Oil- and water-resistant neoprene.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti Inc.
 - 5. Loos & Co.; Seismic Earthquake Division.
 - 6. Mason Industries.
 - 7. TOLCO Incorporated; a brand of NIBCO INC.
 - 8. Unistrut; Tyco International, Ltd.

- D. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to DSA.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least 4 times the maximum seismic forces to which they will be subjected.
- E. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- F. Restraint Cables: ASTM A 603 galvanized steel cables in concealed spaces and ASTM A 492 stainless-steel cables in areas exposed to view in public spaces. Both shall have end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- G. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod. Do not weld stiffeners to rods.
- H. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- K. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- L. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.

3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to DSA.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
 1. Install restrained isolators on electrical equipment.
 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
 3. Install seismic-restraint devices using methods approved by DSA.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
 9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 26 05 48

SECTION 26 05 55 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

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 computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.
 - 1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.3 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- C. Qualification Data: For coordination-study specialist.
- D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital form.
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Study and Equipment Evaluation Reports.
 - 3. Coordination-Study Report.

1.4 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:
- B. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the drawings or a product by one of the following:
 1. CGI CYME.
 2. EDSA Micro Corporation.
 3. ESA Inc.
 4. Operation Technology, Inc.
 5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
 1. Optional Features:
 - a. Arcing faults.
 - b. Simultaneous faults.
 - c. Explicit negative sequence.
 - d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
 - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
 - 1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 - 2. Impedance of utility service entrance.
 - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
 - a. Circuit-breaker and fuse-current ratings and types.
 - b. Relays and associated power and current transformer ratings and ratios.
 - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
 - d. Generator kilovolt amperes, size, voltage, and source impedance.
 - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
 - f. Busway ampacity and impedance.
 - g. Motor horsepower and code letter designation according to NEMA MG 1.
 - 4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.

- h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
- i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
 - 1. Switchgear and switchboard bus.
 - 2. Medium-voltage controller.
 - 3. Motor-control center.
 - 4. Distribution panelboard.
 - 5. Branch circuit panelboard.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 or IEEE 241 and IEEE 242.
 - 1. Transformers:
 - a. ANSI C57.12.10.
 - b. ANSI C57.12.22.
 - c. ANSI C57.12.40.
 - d. IEEE C57.12.00.
 - e. IEEE C57.96.
 - 2. Medium-Voltage Circuit Breakers: IEEE C37.010.
 - 3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
 - 4. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:
 - 1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
 - 2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
 2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
 3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 141 or IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.
- E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

- a. Device tag.
 - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
 - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
 - d. Fuse-current rating and type.
 - e. Ground-fault relay-pickup and time-delay settings.
2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
- a. Device tag.
 - b. Voltage and current ratio for curves.
 - c. Three-phase and single-phase damage points for each transformer.
 - d. No damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum fault-current cutoff point.
- G. Completed data sheets for setting of overcurrent protective devices.

END OF SECTION 26 05 55

SECTION 26 05 72 - ACCEPTANCE TESTING

PART 1- GENERAL

- 1.1 It is the intent of these acceptance tests to assure that all Contractor supplied equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with designed specifications.
- A. The acceptance tests and inspections shall determine suitability for energization of switchgear and cables.
- B. Items that shall be checked, inspected, and tested include, but are not limited to, the following:
1. Relays.
 2. Power/Lighting panelboards.
 3. 600V rated cable.
 4. Lighting System
- 1.2 APPLICABLE CODES
- A. All inspections and tests shall be in accordance with the following applicable codes and standards except as provided otherwise herein.
1. California Electrical Code - CEC 2016 Edition.
 2. National Electrical Manufacturer's Association - NEMA.
 3. American Society for Testing and Materials - ASTM.
 4. Institute of Electrical and Electronic Engineers - IEEE.
 5. National Electrical Testing Association - NETA.
 6. American National Standards Institute - ANSI:
 - a. C2, National Electrical Safety Code
 - b. Z244-1, American National Standard for Personnel Protection
 7. State Codes and Ordinances.
 8. Insulated Cable Engineers Association - ICEA.
 9. Association of Edison Illuminating Companies - AEIC.
 10. Occupational Safety and Health Administration:
 - a. Part 1910, Subpart S, 1910.308
 - b. Part 1926, Subpart V, 1926.950 through 1926.960
 11. National Fire Protection Association - NFPA:
 - a. CEC, Electrical Equipment Maintenance
 - b. CEC, Electrical Safety Requirements for Employee Workplaces

- c. ANSI/NFPA 70, California Electrical Code 2016 Edition
- d. ANSI/NFPA 78, Lightning Protection Code
- e. ANSI/NFPA 101, Life Safety Code
- f. 2016 Title 24 Energy Guidelines, Chapter 8

12. All inspections and tests shall utilize the following references:

- a. Project Design Specification.
- b. Project Design Drawings.
- c. Manufacturer's instruction manuals applicable to each particular apparatus.

1.3 QUALIFICATIONS OF TESTING AGENCY

- A. The testing firm shall be an independent testing organization, which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.
- B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.
- C. The testing firm and all the testing personnel shall have been engaged in such practices for a minimum of ten years.
- D. The testing firm shall meet federal OSHA criteria for accreditation of testing laboratories, Title 29, Parts 1907, 1910, and 1936. Full membership in the National Electrical Testing Association constitutes proof of such criteria.
- E. The lead, on site, technical person shall be currently certified by the National Electrical Testing Associate (NETA) in Electrical Power Distribution System Testing.
- F. Testing firm shall utilize only full-time technicians who are regularly employed by the firm for testing services. Electrically unskilled employees are not permitted to perform testing or assistance of any kind. Electricians may assist, but may not perform testing and/or inspection services.
- G. The testing firm shall submit proof of the above qualifications.
- H. The testing firm shall be an independent organization as defined by OSHA Title 29, Part 1936 and the National Electrical Testing Association.
- I. All instruments used by the testing firm to evaluate electrical performance shall meet NETA's Specifications for Test Instruments. (See Section 1.7 of this specification).
- J. The terms used herewith such as Test Agency, Testing Laboratory, or Contractor Test Company, shall be construed to mean testing firm.

1.4 RESPONSIBILITIES

- A. The Contractor shall notify the Owners Representative prior to commencement of any testing.
- B. Any system, material or workmanship, which is found defective on the basis of acceptance tests, shall be reported.
- C. The testing firm shall maintain a written record of all tests and upon completion of project, assemble and certify a final test report.
- D. A stable source of 60 hertz power shall be provided for testing purposes by the Contractor. Owners Representative shall witness all tests and a minimum of 14 days notice shall be provided.

1.5 TEST EQUIPMENT

- A. Test Instrument Calibration
 - 1. The testing firm shall have a calibration program that assures that all applicable test instrumentation is maintained within rated accuracy.
 - 2. The accuracy shall be directly traceable to the National Bureau of Standards.
 - 3. Instruments shall be calibrated in accordance with the following frequency schedule:
 - a. Field instruments: Analog - 6 months maximum
 Digital - 12 months maximum
 - b. Laboratory Instruments – 2 months
 - c. Leased specialty equipment - 12 months (where accuracy is guaranteed by lessor)
 - 4. Dated calibration labels shall be visible on all test equipment.
 - 5. Records must be kept up-to-date which show date and results of instruments calibrated or tested.
 - 6. An up-to-date instrument calibration instruction and procedure will be maintained for each test instrument.
 - 7. Calibrating standard shall be of higher accuracy than that of the instrument tested.

1.6 TEST REPORTS

- A. The test report shall include the following:
 - 1. Summary of project.
 - 2. Description of equipment/device tested.
 - 3. Description of test, including date, time, and duration of test.
 - 4. Test results.
 - 5. Conclusions and recommendations.
 - 6. Appendix, including appropriate test forms.
 - 7. Identification of test equipment used.
 - 8. Signature of responsible test organization authority.
 - 9. Signature of the person witnessing the tests.
 - 10. Furnish five copies of the complete report to the Owners Representative no later than thirty (30) days after completion of project unless otherwise directed.

1.7 SAFETY AND PRECAUTIONS

- A. Safety practices shall include, but are not limited to, the following requirements:
 - 1. Occupational Safety and Health Act of 1970 - OSHA.
 - 2. Accident Prevention Manual for Industrial Operations, National Safety Council, Chapter 4.
 - 3. Applicable State safety operating procedures.
 - 4. NETA Safety/Accident Prevention Program.
 - 5. District's safety practices.
 - 6. National Fire Protection Association - NFPA 70E.
 - 7. ANSI Z244.1 American National Standards for Personnel Protection.
- B. All tests shall be performed with apparatus de-energized except where otherwise specifically required.
- C. The testing firm shall have a designated safety representative on the project to supervise operations with respect to safety.

PART 2 - PROTECTIVE DEVICE COORDINATION STUDY

- A. A protective coordination study shall be performed using SKM's Dapper or equal software to select or check the selection of power fuse ratings, protective relay characteristics and settings, ratios, and characteristics of associated voltage breaker trip characteristics and settings.
- B. The coordination study shall include all voltage classes of equipment indicated on the single line diagram drawings. The entire electrical system shall be included in the coordination study. Verify characteristics and settings of existing devices in the field and from the manufacturer.
- C. The time-current characteristics of the specified protective devices shall be plotted on the appropriate log-log paper. The plots shall include complete titles, representative one-line diagrams of both buildings and legends, associated relays or fuse characteristics, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves, and fuse curves. The coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, cable damage curves, symmetrical and asymmetrical fault currents. All requirements of the current California Electrical Code shall be adhered to. Reasonable coordination intervals and separation of characteristic curves shall be maintained. Separate coordination plots for phase and ground protective devices shall be provided on a system basis. Separate curves shall be used to clearly indicate the coordination achieved for feeder breakers with downstream fuses and circuit breakers in switchgear and substations. There shall be a maximum of six protective devices per plot.
- D. The selection and setting of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios, manufacturer, type, range of adjustment, and recommended settings. Discrepancies, problem areas, or inadequacies shall be promptly brought to the project Owners Representative's attention.
- E. Five copies of coordination curves and tabulated data indicating selection and settings of protective devices shall be submitted to the Owners Representative for approval.

PART 3 - EQUIPMENT VERIFICATIONS, TESTS AND CALIBRATIONS

3.1 GENERAL

- A. As part of the contract, the Contractor shall perform tests of installed work as herein specified and specified in other Sections of these Specifications.
- B. The Contractor shall provide all materials, equipment, labor and technical supervision to perform such tests and inspections.
- C. All tests shall be performed in compliance with the recommendations and requirements of the National Electrical Testing Association, Inc. (NETA), and applicable codes and standards.
- D. Upon completion of the tests and inspections noted in these Specifications, a label shall be attached to all serviced devices. These labels shall indicate date serviced and the service company responsible.
- C. The test and inspections shall determine suitability for continued reliable operation.
- D. All tests shall be conducted in the presence of the Owners Representative. Provide a minimum of two weeks notice to the Owners Representative.
- E. Furnish the necessary equipment and personnel to perform all required tests of all wiring and connections for continuity, short circuit, and improper grounds. Included, but not limited to, the following systems: substations, air interrupting switches, low voltage main and feeder circuit breakers, interlocking controls, panelboards, distribution transformers, branch circuits.

3.2 SWITCHGEAR, SUBSTATIONS, DISTRIBUTION BOARDS, AND EMERGENCY SYSTEM-GENERAL

- A. Visual and mechanical inspection:
 - 1. Inspect for physical damage and code violations.
 - 2. Clean interior and exterior surfaces.
 - 3. Inspect for proper alignment, anchorage, and grounding.
 - 4. Check tightness of accessible bolted bus joints by torque wrench method. Tighten connections in accordance with industry standard torque levels.
 - 5. Make closure attempt on locked open devices. Make opening attempt on locked closed devices.
 - 6. Make exchange with devices operated in off-normal positions.
- B. Electrical tests:
 - 1. Measure insulation resistance of each bus section phase-to-phase and phase-to-ground.
 - 2. Inspect all accessible bus joints and cable connections by infrared scanner to detect loose or high-resistance connections and other circuit anomalies.
 - 3. Inspect correctness of control wiring.

3.3 BATTERY SYSTEM

A. Visual and mechanical inspection:

1. Inspect for physical damage, anchorage, electrolyte leakage and level.
2. Check intercell bus link and cable connection integrity for tightness and corrosion.

B. Electrical tests:

1. Measure system charging voltage and each individual cell voltage.
2. Measure electrolyte specific gravity.
3. Perform infrared scan of the intracell links cable connections under current discharge conditions.

3.4 INSTRUMENT TRANSFORMER

A. Visual and mechanical inspection:

1. Inspect for physical damage and connection tightness.
2. Check transformer nameplate with singleline diagram.
3. Check proper operation of grounding or shorting devices.

B. Electrical tests:

1. Measure current transformer ratio by primary current injection.
2. Measure potential transformer ratio.
3. Measure insulation resistance primary-to-ground, secondary-to-ground and primary-to-secondary.
4. Verify secondary wiring connections by secondary current injection.
5. Verify transformer polarity markings.
6. Perform current transformer saturation test. Plot transformer voltage current curve.

3.5 CONTROL POWER TRANSFORMERS - ENCAPSULATED TYPE

A. Visual and mechanical inspection:

1. Inspect for physical damage, proper installation, anchorage, and grounding.
2. Clean interior and all bushing and insulator surfaces.
3. Verify proper auxiliary device operation such as fans and indicators.
4. Check tightness of accessible bolted electrical joints. Tighten connections in accordance with industry standards.

B. Electrical tests:

1. Perform insulation resistance tests winding-to-winding and winding-to-ground. Apply appropriate guard circuit over all bushings.
2. Perform dielectric absorption test winding-to-winding and winding-to ground for ten (10) minutes. Compute the polarization index.
3. Perform turns ratio test between windings for all tap positions.
4. Perform insulation power factor tests on all high and low-voltage windings.
5. Check output voltages.

3.6 PROTECTIVE RELAYS

A. Visual and mechanical inspection:

1. Inspect relays for physical damage, presence of foreign material, moisture, condition of spiral spring, disc clearance and corrosion.
2. Clean cover glass interior and relay components.
3. Check for freedom of movement, proper travel and alignment, and tightness of mounting hardware and top screws.

B. Electrical test:

1. Perform insulation resistance tests on each circuit branch to frame.
2. Perform the following tests at the settings specified by Owners Representative:
 - a. Pickup parameters on each operating element.
 - b. Timing at three (3) points on time dial curve.
 - c. Pickup target and seal in units.
 - d. Special test as required to check operation of restraint, and other elements per manufacturer's instructions.
3. Perform phase angle and magnitude contribution tests on all differential type relays after energization to vectorially prove proper polarity and connection.
4. Check polarity and correctness of control wiring.

C. Relay calibration and tests:

1. Two relay wiring tests shall be made.
 - a. Primary circuit polarity test shall include a DC test from the current transformer to each terminal block and relay terminal.
 - b. Relay and circuit breaker operation test by application of power from the portable relay test set.

D. Relay testing shall be accomplished after completion of the switchgear installation, using standard portable test set equipment and the relay manufacturer's testing directions and parameters to determine conformance of the relay to the time-overcurrent information given in the manufacturer's performance curves and the tap settings provided by coordination study. Overcurrent relay testing shall include:

1. Zero set tests.
2. Pickup tests.
3. Time-current characteristic (operation at currents 3 and 4 times the directed tap settings), and instantaneous at the directed tap setting.
4. Target and seal-in operation.

E. Target differential relays shall be tested similarly, except for the following additional tests:

1. Low voltage "through-currents" of approximately "full load" and "fault" magnitudes shall be circulated in HV busses. Bus differential relays shall not trip.
2. Low voltage currents shall be circulated within the differential zones of "low-fault" and "high-fault"

magnitudes. Bus differential relays shall initiate tripping momentarily.

3.7 LOW VOLTAGE CIRCUIT BREAKERS

A. Visual and mechanical inspection:

1. Inspect for physical condition.
2. Inspect alignment and grounding.
3. Perform mechanical operator and contact alignment tests on the breaker and its operating mechanism in accordance with manufacturer's instructions.
4. Perform insulation resistance test on control wiring.
5. Clean mechanism, insulating surfaces and contacts.

B. Electrical tests:

1. Measure contact resistance.
2. Trip overcurrent protective device by operation of each protective device.
3. Perform an insulation resistance test phase-to-ground, phase-to-phase and across open contacts.
4. Perform insulation resistance test in accordance with Doble procedure.
5. Perform timing test with Travel Analyzer to insure proper contact overtravel and pressure.

3.8 CABLES, LOW VOLTAGE (600 VOLTS AND LESS)

A. Visual and mechanical inspections:

1. Inspect cables for physical damage and proper connection.
2. Torque test cable connection. Tighten connections in accordance with industry standards.
3. Perform infrared scan of all connections under loaded conditions.

B. Electrical tests:

1. Perform insulation resistance test of each cable with respect to ground and adjacent cables.

3.9 GROUNDING SYSTEMS

A. Visual and mechanical inspection:

1. Inspect ground system connections for completeness and adequacy.

B. Electrical tests:

1. Perform fall-of-the-potential test per IEEE No. 81, Section 9.03 to determine the ground resistance between the main grounding system and all major electrical equipment frames, system neutral and/or derived neutral points.

C. INFRARED INSPECTION

1. All doors and cover shall be removed and upon completion of test be reinstalled by testing agency technicians.
2. A load bank shall be furnished to circulate low voltage currents of 400A magnitude through each bus, main breaker and feeder breaker. After two hours infrared scans shall be made of all bus joints. Problem area shall be photographed before and after corrections. After corrections, another current test of two hours duration shall be made. Again an infrared scan shall be made to confirm correct operation.
3. Upon completion, the switchgear shall be energized at 12kV. After 4 hours, infrared scans shall be made to determine areas of excessive corona. Problem area shall be treated the same as under B., above.
4. Upon completion of infrared scans, all covers and doors shall be reinstalled.

END OF SECTION 26 05 72

SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

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 types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
 - 1. Distribution transformers.

1.3 SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- D. Qualification Data: For testing agency.
- E. Source quality-control test reports.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
- C. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."
- F. Transformer must bear the UL Energy Efficiency Verification Mark to confirm that the unit meets the requirements of 10 CFR Part 431.
- G. Provide Seismic tested equipment as follows:
 - 1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the [latest California Building Code (CBC) with OSHPD Amendments].
 - 2. The Structural Engineer of Record will evaluate the SDS values published on the [Manufacturer's] website to ascertain that they are "equal to" or "greater than" those required for the Project Site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 2. General Electric Company.
 - 3. Square D; Schneider Electric.

2.2 RATINGS

- A. The kVA and voltage ratings shall be as indicated on the drawings.
- B. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.
- C. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".
- D. Transformers efficiency shall be measured according to federal law 10 CFR Part 431.
- E. Transformers sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

Equivalent Winding kVA Range	Self Cooled Ventilated		Self Cooled Sealed
	K-Factor=1 K-Factor=4 K-Factor=9	K-Factor=13 K-Factor=20	
3.00 and below	40	40	45
3.01 to 9.00	40	40	45
9.01 to 15.00	45	45	50
15.01 to 30.00	45	45	50
30.01 to 50.00	45	48	50
50.01 to 75.00	50	53	55
75.01 to 112.50	50	53	55
112.51 to 150.00	50	53	55
150.01 to 225.00	55	58	57
225.01 to 300.00	55	58	57
300.01 to 500.00	60	63	59
500.01 to 700.00	62	65	61
700.01 to 1000.00	64	67	63
Greater than 1000	Consult Factory	Consult Factory	Consult Factory

- F. Where K-factor transformers are indicated on the drawings, the transformers shall be specifically designed to supply circuits with a harmonic profile equal to or less than a K-factor of indicated on drawings without exceeding 115 degrees C temperature rise.

2.3 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Core and Coil Assemblies
- Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core

laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade copper with continuous wound construction.

2. Terminals shall be welded to the leads of the coils for better conductivity, less maintenance, and lower risk of hot spots. Terminals shall not be spot welded or bolted to the coil leads.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

2.4 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20/ANSI C89.2, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Enclosure: Ventilated EMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

D. Enclosure: Ventilate NEMA 250.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Standard Gray.

F. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.

G. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

H. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.

I. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.

- J. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
 - 1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
 - 2. Include special terminal for grounding the shield.
 - 3. Shield Effectiveness:
 - a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
 - b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
 - c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.
- K. Wall Brackets: Manufacturer's standard brackets.
- L. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.
- M. Low-Sound-Level Requirements: Maximum sound levels, when factory tested according to IEEE C57.12.91, as follows:
 - 1. 9 kVA and Less: 35 dBA
 - 2. 30 to 150 kVA: 45dBA
 - 3. 151 to 300 kVA: 50 dBA
 - 4. 301 to 500 kVA: 55 dBA

2.5 BUCK-BOOST TRANSFORMERS

- A. Description: Self-cooled, two-winding dry type, rated for continuous duty and with wiring terminals suitable for connection as autotransformer. Transformers shall comply with NEMA ST 1 and shall be listed and labeled as complying with UL 506 or UL 1561.
- B. Enclosure: Ventilated, NEMA 250, Type 2.
 - 1. Finish Color: Standard Gray

2.6 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.7 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.

- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by CEC and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.
 - 1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- C. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- E. Remove and replace units that do not pass tests or inspections and retest as specified above.
- F. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 - 2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
 - 3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- G. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 22 00

SECTION 26 24 13 - SWITCHBOARDS

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 service and distribution switchboards rated 600 V and less.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.
- F. CEC: California Electrical Code.

1.4 SUBMITTALS

- A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of switchboards and overcurrent protective devices.

- d. Descriptive documentation of optional barriers specified for electrical insulation and isolation.
 - e. Utility company's metering provisions with indication of approval by utility company.
 - f. Mimic-bus diagram.
 - g. UL listing for series rating of installed devices.
 - h. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples: Representative portion of mimic bus with specified finish, for color selection.
- D. Manufacturer Seismic Qualification Certification: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- E. Qualification Data: For testing agency.
- F. Field quality-control test reports including the following:
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- G. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 1. Routine maintenance requirements for switchboards and all installed components.
 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 3. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
- C. Source Limitations: Obtain switchboards through one source from a single manufacturer.
- D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- E. 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.
- F. Comply with NEMA PB 2, "Deadfront Distribution Switchboards."
- G. Comply with CEC.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in sections or lengths that can be moved past obstructions in delivery path.
- B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C. If stored in areas subjected to weather, cover switchboards to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchboards; install electric heating (250 W per section) to prevent condensation.
- D. Handle switchboards according to NEMA PB 2.1 and NECA 400.

1.7 PROJECT CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

- B. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2000 m).
- C. Service Conditions: NEMA PB 2, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).
- D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect and Owner no fewer than 14 days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without the Architect's and Owners written permission.

1.8 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

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. Potential Transformer Fuses: Equal to 10 percent of amount installed for each size and type, but no fewer than 2 of each size and type.
 - 2. Control-Power Fuses: Equal to 10 percent of amount installed for each size and type, but no fewer than 2 of each size and type.
 - 3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of amount installed for each size and type, but no fewer than 3 of each size and type.
 - 4. Fuses for Fused Switches: Equal to 10 percent of amount installed for each size and type, but no fewer than 3 of each size and type.
 - 5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of amount installed for each size and type, but no fewer than 3 of each size and type.
 - 6. Indicating Lights: Equal to 10 percent of amount installed for each size and type, but no fewer than 1 of each size and type.

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. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MANUFACTURED UNITS

- A. Manufacturers:
1. Eaton Corporation; Cutler-Hammer Products.
 2. General Electric Co.; Electrical Distribution & Protection Div.
 3. Siemens Energy & Automation, Inc.
 4. Square D.
- B. Front-Connected, Front-Accessible Switchboard: Panel Mounted main device, panel-mounted branches, and sections rear aligned.
- C. Nominal System Voltage: As noted on drawings.
- D. Main-Bus Continuous: Ampere rating as noted on drawings.
- E. Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- F. Enclosure: Steel, NEMA 250, Type 1 or NEMA 3R.
- G. Enclosure Finish for Outdoor Units: Factory-applied finish in manufacturer's standard color, undersurfaces treated with corrosion-resistant undercoating.
- H. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- I. Barriers: Between adjacent switchboard sections.
- J. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

- K. Utility Metering Compartment: Fabricated compartment and section complying with utility company's requirements (where required). If separate vertical section is required for utility metering, match and align with basic switchboard.
- L. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- M. Removable, Hinged Rear Doors and Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.
- N. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- O. Pull Box on Top of Switchboard:
 - 1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
 - 2. Set back from front to clear circuit-breaker removal mechanism.
 - 3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
 - 4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
 - 5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.
- P. Buses and Connections: Three phase, four wire, unless otherwise indicated.
 - 1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity with feeder circuit-breaker line connections.
 - a. If bus is copper, use copper for feeder circuit-breaker line connections.
 - 2. Load Terminals: Insulated, rigidly braced, silver-plated, copper runback bus extensions equipped with pressure connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full ampere rating of circuit-breaker position.
 - 3. Ground Bus: 1/4-by-2-inch- (6-by-50-mm-) minimum-size, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 - 4. Contact Surfaces of Buses: Silver plated.
 - 5. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 - 6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
 - 7. Neutral Buses: 100 percent of the ampacity of phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus are braced.
- Q. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

- R. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating: 105 deg C.

2.3 TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. IEEE C62.41, integrally mounted, plug-in-style, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules.
- B. Minimum single-impulse current rating shall be as follows:
 - 1. Line to Neutral: 100,000 A.
 - 2. Line to Ground: 100,000 A.
 - 3. Neutral to Ground: 50,000 A.
- C. Protection modes shall be as follows:
 - 1. Line to neutral.
 - 2. Line to ground.
 - 3. Neutral to ground.
- D. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55 dB at 100 kHz.
- E. Maximum Category C combination wave clamping voltage shall not exceed 600 V, line to neutral and line to ground on 120/208 V; 1000 V, line to neutral and line to ground on 277/480 V systems.
- F. Maximum UL 1449 clamping levels shall not exceed 400 V, line to neutral and line to ground on 120/208 V; 800 V, line to neutral and line to ground on 277/480 V systems.
- G. Withstand Capabilities: 3000 Category C surges with less than 5 percent change in clamping voltage.
- H. Accessories:
 - 1. Form-C contacts, one normally open and one normally closed, for remote monitoring of system operation. Contacts to reverse position on failure of any surge diversion module.
 - 2. Audible alarm activated on failure of any surge diversion module.
 - 3. Six-digit transient-counter set to total transient surges that deviate from the sine-wave envelope by more than 125 V.

2.4 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip-unit circuit breakers shall have RMS sensing, field-replaceable rating plug, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 6. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 4. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system, specified in Division 26.
 5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 9. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
- C. Enclosed, Insulated-Case Circuit Breaker: Fully rated, encased-power circuit breaker with interrupting capacity rating to meet available fault current.
1. Fixed circuit-breaker mounting.
 2. Two-step, stored-energy closing.
 3. Microprocessor-based trip units with interchangeable rating plug, LED trip indicators, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments with I^2t response.
 - d. Ground-fault pickup level, time delay, and I^2t response.

4. Remote trip indication and control.
 5. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 6. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 7. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 8. Control Voltage: 125-V, ac.
- D. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.
1. Manufacturers:
 - a. Cutler-Hammer Products; Eaton Corporation.
 - b. Pringle Electrical Mfg. Co.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D.
- E. High-Pressure, Butt-Type Contact Switch: Operating mechanism uses butt-type contacts and a spring-charged mechanism to produce and maintain high-pressure contact when switch is closed.
1. Manufacturers:
 - a. General Electric Co.
 - b. Approved Equal.
 2. Main Contact Interrupting Capability: 12 times the switch current rating, minimum.
 3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for closing and opening.
 - a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
 - b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
 4. Auxiliary Switches: Factory installed, single pole, double throw, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
 5. Service-Rated Switches: Labeled for use as service equipment.
 6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
 - a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.

- c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
 - d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
- 7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.
- F. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- G. Fuses are specified in Division 26 Section "Fuses."

2.5 INSTRUMENTATION

- A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:
 - 1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
 - 2. Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
 - 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kV.
 - 4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondaries to ground overcurrent relays to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 - 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Megawatts: Plus or minus 2 percent.
 - e. Megavars: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.
 - i. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent. Accumulated values unaffected by power outages up to 72 hours.
 - 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
- C. Ammeters, Voltmeters, and Power-Factor Meters: ANSI C39.1.
 - 1. Meters: 4-inch (100-mm) diameter or 6 inches (150 mm) square, flush or semiflush, with antiparallax 250-degree scales and external zero adjustment.

- 2. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.
- D. Instrument Switches: Rotary type with off position.
 - 1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.
 - 2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.
- E. Feeder Ammeters: 2-1/2-inch- (64-mm-) minimum size with 90- or 120-degree scale. Meter and transfer device with an off position, located on overcurrent device door for indicated feeder circuits only.
- F. Watt-Hour Meters: Flush or semiflush type, rated 5 A, 120 V, 3 phase, 3 wire, with 3 elements, 15-minute-indicating-demand register, and provision for testing and adding pulse initiation.
- G. Recording Demand Meter: Usable as totalizing relay or as indicating and recording maximum-demand meter with 15-minute interval. Meter shall count and control a succession of pulses entering two channels. House in drawout, back-connected case arranged for semiflush mounting.

2.6 CONTROL POWER

- A. Control Circuits: 120 V, supplied through secondary disconnecting devices from control-power transformer.
- B. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
- C. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- D. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Furnish portable test set to test functions of solid-state trip devices without removal from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

- C. Furnish one portable, floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.
- D. Furnish overhead circuit-breaker lifting device, mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker.
- E. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.
- F. Fungus Proofing: Permanent fungicidal treatment for switchboard interior, including instruments and instrument transformers.

2.8 IDENTIFICATION

- A. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.
- B. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.
- C. Accessories: A new printed single line diagram of the entire electrical distribution system as shown on the single line diagram shall be framed, plastic laminated, and mounted in the switchboard electrical room at each building. The diagram shall be a permanent black on white mylar at least 30" x 42" in size, professionally printed and framed.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.2 EXAMINATION

- A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1 and NECA 40.
- B. Install and anchor switchboards level on concrete bases, 4-inch (100-mm) nominal thickness minimum. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 03.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
 - 2. For switchboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- E. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- F. Install spare-fuse cabinet.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.

- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- D. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
 - c. Instruments, Equipment, and Reports:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2) Prepare a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 24 13

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Load centers.
 - 4. Transient voltage suppression panelboards.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. UL listing for series rating of installed devices.

- e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - f. Future metering spacing compliance with 2016 Energy/Electrical Codes.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems" Include the following:
 - 1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Qualification Data: For testing agency.
- E. Field quality-control test reports including the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
- C. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with NEMA PB 1.
- G. Comply with CEC.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect and Owner no fewer than 14 days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Architects and Owners written permission.

1.7 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 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. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PART 2 - PRODUCTS

PART 3 -

SCHEDULE 0 -

PRODUCT DATA SHEET 0 -

3.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton Corporation; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Protection Div.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D.
 - 2. Transient Voltage Suppression Panelboards:
 - a. Current Technology.
 - b. Liebert Corporation.

3.2 MANUFACTURED UNITS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1.
 - 1. Rated for environmental conditions at installed location.
 - a. Outdoor Locations: NEMA 250, Type 3R unless noted otherwise.
 - b. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - d. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 6. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
 7. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
 8. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.
 9. Identifying nameplate with full description as specified in Section 260553.
- C. Phase and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
 3. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
 4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
 5. Split Bus: Vertical buses divided into individual vertical sections.
- D. Conductor Connectors: Suitable for use with conductor material.
1. Main and Neutral Lugs: Compression type.
 2. Ground Lugs and Bus Configured Terminators: Compression type.
 3. Feed-Through Lugs: Compression type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 4. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- E. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- F. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- 3.3 PANELBOARD SHORT-CIRCUIT RATING
- A. UL label indicating connected rating with integral or remote upstream overcurrent protective devices. Include size and type of upstream device allowable, branch devices allowable, and UL connected short-circuit rating. Series rated panels and related circuit breakers are not acceptable.
- B. Fully rated to interrupt symmetrical short-circuit current available at terminals.
- 3.4 DISTRIBUTION PANELBOARDS
- A. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.
- B. Main Overcurrent Protective Devices: Circuit Breaker.

- C. Branch Overcurrent Protective Devices:
 - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on type circuit breakers.
 - 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

3.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Bolt-on type circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

3.6 LOAD CENTERS

- A. Overcurrent Protective Devices: Plug-in, full-module circuit breaker.
- B. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

3.7 TRANSIENT VOLTAGE SUPPRESSION PANELBOARDS

- A. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- B. Main Overcurrent Devices: Thermal-magnetic circuit breaker.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.
- D. Bus: Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
- E. Transient Voltage Suppression Device: IEEE C62.41, integrally mounted, plug-in-style, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules.
 - 1. Minimum Single-Impulse Current Ratings:
 - a. Line to Neutral: 100,000 A.
 - b. Line to Ground: 100,000 A.
 - c. Neutral to Ground: 50,000 A.
 - 2. Protection modes shall be as follows:
 - a. Line to neutral.
 - b. Line to ground.
 - c. Neutral to ground.
 - 3. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55 dB at 100 kHz.
 - 4. Maximum Category C Combination Wave Clamping Voltage: 600 V, line to neutral and line to ground on 120/208 V. and 1000 V, line to neutral and line to ground on 277/480 V. systems.
 - 5. Maximum UL 1449 Clamping Levels: 400 V, line to neutral and line to ground on 120/208 V. and 800 V, line to neutral and line to ground on 277/480 V. systems.
 - 6. Withstand Capabilities: 3000 Category C surges with less than 5 percent change in clamping voltage.
 - 7. Accessories:

- a. Form-C contacts, one normally open and one normally closed, for remote monitoring of system operation. Contacts to reverse position on failure of any surge diversion module.
- b. Audible alarm activated on failure of any surge diversion module.
- c. Six-digit transient-counter set to total transient surges that deviate from the sine-wave envelope by more than 125 V.

3.8 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 6. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
 1. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 4. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
 5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 9. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 10. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.

- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- D. Fuses are specified in Division 26 Section "Fuses."

3.9 CONTROLLERS

- A. Motor Controllers: NEMA ICS 2, Class A, combination controller equipped for panelboard mounting and including the following accessories:
 - 1. Individual control-power transformers.
 - 2. Fuses for control-power transformers.
 - 3. Bimetallic-element overload relay.
 - 4. Indicating lights.
 - 5. Seal-in contact.
 - 6. 2 convertible auxiliary contacts.
 - 7. Push buttons.
 - 8. Selector switches.
- B. Contactors: NEMA ICS 2, Class A, combination controller equipped for panelboard mounting and including the following accessories:
 - 1. Individual control-power transformers.
 - 2. Fuses for control-power transformers.
 - 3. Indicating lights.
 - 4. Seal-in contact.
 - 5. 2 convertible auxiliary contacts or as otherwise indicated on drawings.
 - 6. Push buttons.
 - 7. Selector switches.
- C. Controller Disconnect Switches: Adjustable instantaneous-trip circuit breaker integrally mounted and interlocked with controller.
 - 1. Auxiliary Contacts: Integral with disconnect switches to de-energize external control-power source.
- D. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held general-purpose controller.
 - 1. Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. Control-Power Source: 120-V branch circuit.

3.10 ACCESSORY COMPONENTS AND FEATURES

- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Furnish portable test set to test functions of solid-state trip devices without removal from panelboard.
- C. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.

PART 4 - PART 3 - EXECUTION

PART 5 -

SCHEDULE 0 -

PRODUCT DATA SHEET 0 -

5.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish. Where panelboards are recessed into fire rated walls, notify Architect immediately of condition and provide additional furring of wall (and related drywall) to bring panelboard front flush with finished surface.
- E. Install overcurrent protective devices and controllers.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Stub five 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing in a neat and professional manor.

5.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads (after balancing panelboard loads). Obtain approval from Architect of description or areas served before installing. The Contractor shall be responsible for updating directories to indicate actual area served which is not necessarily the description indicated on the bid documents. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

- C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws or rivets. Refer to Section 260553 for additional requirements.

5.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

5.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- D. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- E. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.
- F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.

2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

5.5 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris prior to pulling any conductors; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Wall switches.
- B. Receptacles.
- C. Device plates and decorative box covers.
- D. Time switches.

1.2 REFERENCES

- A. NEMA WD 1 - General-Purpose Wiring Devices.
- B. NEMA WD 6 - Wiring Device Configurations.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

- A. Single Pole Switch:
 - 1. Hubbell, Model 2121-W.
 - 2. Leviton, Model 5621-2W.
 - 3. Equal by Arrow Hart or Bryant.
- B. Double Pole Switch:
 - 1. Hubbell, Model 2122-W.
 - 2. Leviton, Model 5622-2W.
 - 3. Equal by Arrow Hart or Bryant.
- C. Three-way Switch:
 - 1. Hubbell, Model 2123-W.
 - 2. Leviton, Model 5623-3W.

- 3. Equal by Arrow Hart or Bryant.
- D. Substitutions: Under provisions of Division 01.
- E. Description: NEMA WD 1, heavy-duty specification grade, AC only general-use quiet type rocker switch, UL approved for tungsten lamp loads or inductive loads without derating.
- F. Device Body: White plastic with rocker handle.
- G. Ratings: 20A., 120-277V A.C. or as required to match with specific branch circuit and load characteristics.
- H. Lock type switches shall be Hubbell #1221L only per District standards.

2.2 RECEPTACLES

- A. Duplex Convenience Receptacle:
 - 1. Hubbell
 - 2. Leviton
 - 3. Arrow Hart
 - 4. Bryant.
- B. GFCI Receptacle:
 - 1. Hubbell
 - 2. Leviton
 - 3. Arrow Hart
 - 4. Bryant.
- C. Surge Protected Outlets:
 - 1. Hubbell
 - 2. Leviton
 - 3. Arrow Hart
 - 4. Bryant.
- D. Substitutions: Under provisions of Division 01.
- E. Description: NEMA WD 1; heavy-duty general-use receptacle. 20 Amp, 125V, 2-pole, 3-wire style line series.
- F. Device Body: Plastic.
- G. Configuration: NEMA WD 6; type as specified and indicated.
- H. Convenience Receptacle: Type 5-20R
- I. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.3 WALL PLATES

- A. Plates shall be brushed stainless steel and supplied for every local switch, receptacle, telephone and data outlet, wall speaker outlet, etc.
- B. Weatherproof Cover Plate: Gasketed cast metal with hinged gasketed device cover.
- C. Locking Weatherproof Cover Plate: Pass & Seymour Legrand #4600 Series with mounting plates as required or equal at locations indicated on drawings.
- D. Plates shall be engraved and filled, when used for:
 - 1. More than two gangs.
 - 2. Equipment that cannot be seen from the locations.
 - 3. All lock type switches.
 - 4. All receptacles other than 120 volts.
 - 5. All pilot switches.
 - 6. Switches in locations from which the equipment or circuits controlled cannot be readily seen.
 - 7. Manual motor starting switches.
 - 8. Where so indicated on the drawings.
 - 9. As required on all control circuit switches, such as heater controls, etc.

2.4 TIME SWITCHES

- A. Manufacturers:
 - 1. Tork.
 - 2. Paragon.
 - 3. Intermatic.
- B. Description: AC electronic time clock, 7 day.
- C. Input voltage: 120V.
- D. Poles: 40A, 120V, number as indicated. (4 pole minimum)
- E. Enclosure: Type as required to meet installation.
- F. Configuration: 365 Day Astronomic, electronic, programmable.
- G. Accessories: Photocell control as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify outlet boxes are installed at proper height.

- B. Verify wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Install receptacles with grounding pole on top
- E. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- F. Install decorative plates on switches, receptacles, etc., and blank outlets in finished areas.
- G. Connect wiring devices by wrapping conductor around screw terminal.
- H. Use jumbo size plates for outlets installed in masonry walls.
- I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished area, above accessible ceilings, and on surface mounted outlets.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 260533 to obtain mounting heights specified and indicated on drawings.
- B. Install wall switches as indicated on drawings.
- C. Install convenience receptacles 18 inches above finished floor.
- D. Install convenience receptacle 6 inches above backsplash of counter.

3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in enclosed switches panelboards and switchboards.
2. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.
3. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 3. Current-limitation curves for fuses with current-limiting characteristics.
 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 5. Coordination charts and tables and related data.
 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Ambient temperature adjustment information.
 - 2. Current-limitation curves for fuses with current-limiting characteristics.
 - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

1.7 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.8 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Littelfuse, Inc.
 - 5. .

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 PLUG FUSES

- A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.4 PLUG-FUSE ADAPTERS

- A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

2.5 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.
 - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Service Entrance: Class L, time delay.
 - 2. Feeders: Class RK1, time delay.
 - 3. Motor Branch Circuits: Class RK1, time delay.
 - 4. Other Branch Circuits: Class RK1, time delay Class J, time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.
- C. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Division 1 and 26 of the specifications.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES

- A. Lighting fixtures shall be of specification grade and listed or labeled by Underwriters Laboratories (UL) or other approved Nationally Recognized Testing Laboratory. Provide lighting fixtures in accordance with the Fixture Schedule.
- B. Recessed lighting fixtures shall be thermally protected.
- C. LED fixtures shall comply with UL Standard 8750, with IES Standards LM-79 and LM-80, and shall have a parts and labor warranty of 5 years minimum on the fixtures and components.
 - 1. User serviceable LED lamps and drivers shall be replaceable from the room side.
 - 2. Dimmable LED fixtures shall have either a 0-10 volt, 3-wire dimming driver, or a two-step (50%-100%) line voltage, two switch controlled dimming driver.

2.2 DRIVERS

- A. LED drivers shall be electronic, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15, comply with NEMA SSL 1, have a sound rating of "A" and be rated for a THD of less than 20 percent at all input voltages.
- B. Dimmable LED drivers shall be capable of dimming without LED strobing or flicker across their full dimming range.
- C. Drivers shall be rated for the ambient temperatures in which they are located. Outdoor fixtures shall be equipped with ballasts or drivers rated for reliable starting to -20 degrees F. Indoor fixtures located in areas with direct sunlight or above normal ambient temperatures shall have ballasts or drivers rated at 65 degrees C minimum.
- D. Individually fused drivers shall have their fuses accessible from outside of the fixture chassis.

2.3 EMERGENCY LIGHTING

- A. Emergency lighting shall consist of normal lighting fixtures with generator or battery-inverter system backup, emergency lighting fixtures with individual battery backup, or sealed beam emergency lighting units in accordance with the Fixture Schedule.
 - 1. Battery-backed LED emergency lighting fixtures shall consist of a normal LED fixture with some or all of the LEDs connected to a battery and charger. The battery shall be nickel cadmium and sized for a minimum of 90 minutes of fixture operation. The charger shall be solid state and provide overload, short circuit, brownout and low battery voltage protection. The battery and charger shall include self-diagnostic and self-exercising circuitry to exercise and test itself for 5 minutes every month and for 30 minutes every 6 months. The fixture shall include a test/monitor module with LED status indicating lights mounted so as to be visible to the public. The fixture shall not contain an audible alarm.
 - 2. Sealed beam emergency lighting units shall consist of sealed beam LED lamps connected to an internally mounted battery and charger. The battery shall be nickel cadmium and sized for a minimum of 90 minutes of battery operation. The charger shall solid state and provide overload, short circuit, brownout and low battery voltage protection. The unit shall be suitable for wall or ceiling mounting as required. It shall include self-diagnostic and self-exercising circuitry to exercise and test itself for 5 minutes every month and for 30 minutes every 6 months. The unit shall include a test/monitor module with LED status indicating lights mounted so as to be visible to the public. The unit shall not contain an audible alarm.

2.4 EXIT SIGNS

- A. Exit signs shall be of the LED type.
 - 1. LED's shall be wired in parallel to prevent multi-lamp failure, and shall be concealed within the sign by a clear panel and red optical diffuser. Power consumption shall not exceed 5 watts per face.
 - 2. Exit signs shall have white die cast aluminum or polycarbonate housings with universal mounting brackets; brushed aluminum stencil faces with red letters and multidirectional knockout arrows.
 - 3. Exit signs shall be provided with emergency battery packs and battery chargers when required. Batteries shall be maintenance free nickel cadmium, and shall be mounted within the signs.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Support recessed troffers independently of the ceiling grid system by using two safety wires minimum on diagonally opposite corners of the fixtures. Support recessed downlights by using safety wires or by rigidly attaching the fixtures to the building structure or ceiling grid system. Removable T-bar clips shall not be used to attach fixtures to the ceiling grid system.
- B. Install fixtures level, with no gaps between adjacent fixtures or between fixtures and surrounding surfaces. Lenses, reflectors and trims of fixtures shall be properly and uniformly aligned.

- C. Where fixtures are shown with dual switches, control all inner lamps with one switch and all outer lamps with the other switch. Where dimming or occupancy sensor-controlled fixtures are shown, control the fixtures in accordance with the appropriate wiring diagram or manufacturer's instructions.
- D. Connect night light fixtures and emergency lighting fixtures to the hot (unswitched) side of lighting circuits.
- E. Provide an individual feed with ground conductor from a junction box to each lighting fixture. Lighting fixtures shall not be daisy-chained.
- F. Drops to recessed fixtures may be flexible metallic conduit, or manufactured wiring systems may be used where accessible. Fixtures shall be provided with sufficient length to permit removal and lowering of the fixtures 12" below the ceiling.
- G. Provide green grounding conductors back to the panel ground for lighting circuits. Raceways shall not be used as grounding conductors.
- H. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned. Burned out lamps shall be replaced.
- I. Locate emergency lighting remote battery packs and remote test/monitor modules identically so their status indicating lights are visible to the public and they form a straight line when viewed from the end of the corridor or room. Where a suspended ceiling exists, center the status indicating lights in adjacent ceiling tiles.
- J. Mount sealed beam emergency lighting units where shown and aim their lamps to light the egress path as uniformly as possible.
- K. When emergency lighting fixtures contain audible alarms, disable the alarms in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

- A. A visual inspection shall be performed to verify cleanliness and alignment of the fixtures. Misalignment and light leaks shall be corrected, and rattles due to ventilation system vibration shall be eliminated.
- B. An operational test shall be performed to verify that all fixtures light properly, and are switched according to the drawings.

3.3 COMMISSIONING

- A. Perform Commissioning activities per Related Sections above.

END OF SECTION 26 51 00

SECTION 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

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. Communications equipment coordination and installation.
 - 2. Sleeves for pathways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Common communications installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07.

PART 2 - PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.

3. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
4. Pressure Plates: Carbon steel or Stainless steel. Include two for each sealing element.
5. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 27 05 00

SECTION 27 10 01 - TELECOMMUNICATIONS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work under this section includes all final design, material, equipment, supplies, labor, testing, and accessories required to furnish and install a complete Structured Cabling System (SCS), Intercom/PA/Clock System, and CCTV System, as indicated on the drawings and as specified herein. These systems shall be defined as all cables, equipment, products, etc, as indicated on the drawings, and mentioned in these specifications.
- B. It is the intent of the Drawings and Specifications, which are presented in a "design-build" format, for the Contractor to design, provide and install a complete, fully operational, and tested system.
- C. All miscellaneous system components including, but not limited to, cables, termination equipment, punch blocks, patch panels, ladder racks, backboards, equipment racks, speakers, clocks, cameras, enclosures, terminal cabinets, and any other related items shall be furnished and installed complete under this section, such that the system shall perform all functions listed herein in compliance with all of the specified requirements.
- D. Schedule is paramount to the project's success. With this, the structured cabling Contractor will have to be a team player, continually working with the team to facilitate expeditious design, procurement, and construction processes.
- E. This project will be performed in a phased construction format. Each phase of construction will be completely installed, labeled and tested, to the greatest extent physically possible, before moving to the next phase.

1.2 RELATED WORK, STANDARDS, DOCUMENTS AND PUBLICATIONS

- A. Each agency's relative codes, standards, and recommended practices apply to the voice/data cabling systems and their components as specified herein:
 - 1. American National Standards Institute (ANSI)
 - a. ANSI T1.336 Engineering requirements for a universal telecommunications frame
 - b. ANSI T1.404 Network and customer installation interfaces – DS3 and metallic interface specification
 - 2. Building Industry Consulting Service International (BICSI)
 - a. Telecommunications Distribution Methods Manual (TDMM) – latest edition.
 - b. Customer Owned Outside Plant Design Manual (CO-OSP) – latest edition.
 - 3. Comité Consultatif International de Télégraphique et Téléphonique (CCITT)

4. Federal Communications Commission (FCC)
 - a. FCC Rules Part 68
5. American Society for Testing and Materials (ASTM)
 - a. E814-02 Standard Test Method for Fire Tests of Through-Penetration Fire Stops
6. Insulated Cable Engineers Association (ICEA)
 - a. Communications Wire and Cable for Premises Wiring.
7. International Electrotechnical Commission (IEC)
 - a. IEC 61935-01 Generic Cabling Systems - Specification for the testing of balanced communication cabling in accordance with ISO/IEC 11801 Part 1: Installed Cabling
 - b. IEC 61935-02 Generic Cabling Systems - Specification for the testing of balanced communication cabling in accordance with ISO/IEC 11801 Part 2: Patch Cords and Work Area Cords
8. Institute of Electrical and Electronics Engineers (IEEE)
 - a. IEEE 802 Specification for Local Area Networks, latest edition.
 - b. IEEE 802.3an Specification for 10GBASE-T Ethernet, latest edition.
 - c. ANSI/IEEE C62.41 – Guide on the Surge Environment in Low-Voltage (1000V or less) AC Power Circuits, latest edition.
9. International Organization for Standardization (ISO)
 - a. ISO/IEC 11801 Information Technology – Generic Cabling for Customer Premises, latest edition.
 - b. ISO TR 24750 Technical Report
10. National Fire Protection Association (NFPA)
 - a. ANSI/NFPA-70 National Electric Code – Current version as adopted by AHJ (NEC)
 - b. ANSI/NFPA-75 Standard for the protection of information technology equipment
11. National Electrical Manufacturers Association (NEMA)
12. Occupational Safety and Health Administration (OSHA)
13. Telecommunications Industry Association (TIA)
 - a. TIA/EIA-492AAAC Detail Specification for 850nm Laser-Optimized 50 micron Core Diameter/125 micron Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers.
 - b. TIA/EIA-492AAD Detail Specification for 850nm Laser-Optimized 50 micron

Core Diameter/125 micron Cladding Diameter Class Ia Graded-Index
Multimode Optical Fibers Suitable for Manufacturing OM4 Cabled Optical Fiber.

- c. TIA-526-7 Optical Power Loss of Installed Single-Mode Fiber Cable Plant.
 - d. TIA-526-14-B Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; IEC 61280-4-1 Edition 2, Fiber-Optic Communications Subsystem Test Procedure- Part 4-1: Installed Cable Plant- Multimode Attenuation Measurement.
 - e. ANSI/TIA-568-C.0 Telecommunications Cabling for Customer Premises, latest edition.
 - f. ANSI/TIA-568-C.1 Commercial Building Telecommunications Cabling Standard, latest edition.
 - g. ANSI/TIA-568-C.2 Twisted-Pair Telecommunications Cabling and Components Standard, latest edition.
 - h. ANSI/TIA-568-C.3 Optical Fiber Cabling Components Standard, latest edition.
 - i. ANSI/TIA-568-C.4 Broadband Coaxial Cabling and Components Standard, latest edition.
 - j. ANSI/TIA-569-B Telecommunications Pathways and Spaces, latest edition.
 - k. ANSI/TIA/EIA-598-C Optical Fiber Cable Color Coding.
 - l. ANSI/TIA-606-B Administration Standard for Commercial Telecommunications Infrastructure.
 - m. ANSI/TIA-607-B Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, latest edition.
 - n. ANSI/TIA-758-B Customer-Owned Outside Plant Telecommunications Infrastructure Standard, latest edition.
 - o. ANSI/TIA-862-A Building Automation Systems Cabling Standard, latest edition.
 - p. ANSI/TIA-942-A Telecommunications Infrastructure Standard for Data Centers, latest edition.
 - q. ANSI/TIA-1152 Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling, latest edition.
14. Underwriters Laboratories Standards (UL)
- a. UL 5 Surface Metal Raceways and Fittings, latest edition.
 - b. UL 5A Nonmetallic Surface Raceways and Fittings, latest edition.
 - c. UL 5B Strut-Type Channel Raceways and Fittings, latest edition.
 - d. UL 5C Surface Raceways and Fittings for Use with Data, Signal, and Control

Circuits, latest edition.

- e. UL 514A Metallic Outlet Boxes, latest edition.
- f. UL 514B Conduit, Tubing, and Cable Fittings, latest edition.
- g. UL 514C Nonmetallic Outlet Boxes, Flush-Device Boxes, and C overs, latest edition.
- h. UL 514D Cover Plates for Flush-Mounted Wiring Devices, latest edition.
- i. UL 943 Ground-Fault Circuit-Interrupters (GFCI), latest edition.
- j. UL 1363 Relocatable Power Taps, latest edition.
- k. UL 1449 Transient Voltage Surge Suppressors, latest edition.
- l. UL 1685 Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables, latest edition.
- m. UL 1863 Communications-Circuit Accessories, latest edition.

15. Intetech Testing Services ETL SEMKO (ETL)

- B. The Contractor shall be responsible for obtaining and utilizing the latest Structured Cabling, Architectural, and Electrical plans.

1.3 GENERAL REQUIREMENTS

- A. Manufacturer: The term "manufacturer" shall be defined as the company, or group of companies, that actually produces the products meeting the requirements of Section 2 of this document. The manufacturer shall have a minimum of seven - (7) years of experience in manufacturing products of this type and shall be ISO 9001 Certified. The products, summarized in this specification, shall be supplied by a single manufacturer, with the exception of:
 - 1. Data racks and other hardware that is not defined as part of the channel test configuration by ANSI/TIA/EIA568-C.
 - 2. Fiber Optic Cable and Outside Plant (OSP) fiber cable.
 - 3. Channel solutions consisting of cabling and connectivity hardware independently tested as by UL or ETL and that are listed Section 2 of this document.
 - 4. Cables manufactured by another manufacturer specifically called out on the drawings.
- B. Contractor: The term "Contractor" shall be defined as the company, or group of companies, that actually installs the products per Section 3 of this document. The Contractor selected to provide the installation of this system shall be certified by the manufacturer in all aspects of design, installation and testing of the products described herein.
 - 1. The Contractor shall hold a valid State of California C-7 Low-Voltage license, shall

have completed at least ten (10) projects of equal scope, shall have been in business

of furnishing and installing systems of this scope and magnitude for at least the past five (5) consecutive years, and capable of being bonded to assure the Owner's Project Manager of performance and satisfactory service during the guarantee period.

2. The Contractor shall have a minimum of one (1) Registered Communications Distribution Designer (BICSI RCDD) and a minimum of two (2) BICSI TECHNICIAN level technicians on staff as full time employees of the Contractor.
3. All work shall be performed under the supervision of a company accredited and trained by the manufacturer and such accreditation must be presented. Contractor must be accredited a minimum of one hundred eighty (180) days prior to bid submittal date.
4. The Contractor shall be a manufacturer's Authorized Installer and Warranty Station for the equipment offered and shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment.
5. All personnel performing work on this project must have successfully completed the manufacturer's training course prior to performance of any work on this project. Accreditation will consist of individual employee certifications issued by the manufacturer. All personnel engaged in the testing of fiber optic and category-6 metallic premise horizontal and distribution systems must have successfully completed the test equipment manufacturer's training. Certification of such training must be presented prior to any work performed on this project.
6. The Contractor selected for this Project shall adhere to the engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this Project.
7. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of fiber optic cable, and category-6 metallic premise horizontal and distribution systems, and have personnel who are manufacturer trained in the use of such testing tools and equipment.
8. The Contractor shall hold all other licenses required by the legally constituted authorities having jurisdiction over the work.
9. The Contractor shall have the capability to produce the AutoCAD documentation as required elsewhere in this specification.
10. The Contractor shall provide a fingerprint check for all personnel working on School sites. The test shall be performed by the Department of Justice pursuant to California Education Code Section 45125.1.
11. For additional Contractor requirements, see Section 1.06.A.1 (b) of this document in its entirety.

1.4 QUALITY ASSURANCE

- A. It is the intent of these specifications to establish an installation standard of quality for

labor and materials. For any proposed product substitution or when the Contractor intends to include an "or equal" product in the bid pricing, provide a substitution/or-equal request submittal to the Owner's Project Manager for review no later than fifteen (15) calendar days prior to Bid submittal. This report shall include all of the following items:

1. Description of how the proposed product(s) will impact meeting the project completion date, indicate all item(s) with lead times and expected delivery date(s).
 2. Itemized cost comparisons between the proposed product(s) and the listed product(s).
 3. Detailed technical analysis of the electrical and mechanical specification differences between the proposed product(s) and the listed product(s).
 4. ETL "Verified" or UL "Verified" test lab documentation for the proposed product(s) and assemblies proposed.
 5. Proposed product identification, manufacturer literature (specifications and cut sheets).
 6. Name, address and current contact information of several (minimum of 2) similar projects where the substituted product(s) have been used.
 7. Name, address and contact information of the proposed product(s) manufacturer's local representative.
 8. Sample proposed product(s) manufacturer's component and application warranty. Detailed warranty requirements are described in Section 1.10 GENERAL SYSTEM PRODUCT, INSTALLATION AND OVERALL SYSTEM WARRANTY of this document.
- B. The Owner's Design Team/Project Manager must approve any proposed product(s) substitution item in writing. The Owner's Design Team/Project Manager reserves the right to require a complete sample of any proposed product(s) and may request a sample tested by an independent testing consultant to prove equality. The decision of the Owner's Design Team/Project Manager regarding equality of proposed product(s) items will be final.
- C. If a proposed product(s) is given final acceptance by the Owner's Project Manager, the Contractor shall reimburse the Owner's Design Team/Project Manager for the costs to review the proposed product(s) substitution(s), and for any additional engineering charges, and shall pay all charges of other trades resulting from this products use, at no cost to the Owner.
- E. CCTV Qualification Statement
1. Provide a current letter of recommendation from Bosch. The Contractor must be certified with Bosch and be BVMS Certified for at least twelve (12) months prior to letter of recommendation. The letter of recommendation must be provided to the District at time of bid.
 2. Provide individual installer's experience and qualifications, which shall include three (3) years of projects of similar complexity. Include names and locations of two (2) projects successfully completed in the previous three (3) years.

3. Provide documentation stating you have been in the telecommunication contracting business for a minimum of five (5) years under the same name and are located within a four (4) hour response time of the District.
4. Provide BVMS certification documentation of the certified installer for this project at time of bid.
5. Provide complete instructions on correct operation of system to personnel designated by District. All instructions shall be given during one (1) predetermined time period, coordinated with the District Technology

Representative. At the completion of training, the Contractor shall send a confirming letter to the District Technology Representative with the date of instruction, names of District's personnel who were instructed, and a summary statement of the instruction presented.

1.5 GENERAL SUBMITTAL REQUIREMENT

- A. Submittals shall be presented and formatted per the guidelines in the Division 1 section of this RFP package.
- B. All cut sheets shall represent the latest version, part number, and revision of the product. Where multiple products or part numbers appear on a page, a bold arrow or circle shall indicate which product or part numbers are to be used as part of the installation. The submittal shall include all descriptive pages associated with the product, not just the page showing the part number.

1.6 PRE INSTALLATION SUBMITTAL REQUIREMENTS

- A. Within fifteen (15) calendar days after the date of award of the Contract, the Contractor shall submit the following:
 1. Submittal Binder: Submit eight (8) copies of the complete Submittal Binder to the Owner for review. The binder shall consist of five (5) major sections with each section separated by index tabs. Each page in the binder shall be numbered sequentially and shall be summarized in the index.
 - b. The FIRST section shall be the "title sheet" which shall include the submittal date, project title and address, name and contact information of the Contractor, and name of the Owner. Include an Index sheet that shall contain a Table of Contents identifying page numbers for each section and the section's items.
 - c. The SECOND section shall include the following items:
 1. CONTRACTOR'S LICENSE: A copy of the low voltage Contractor's valid State of California C-7 Low-Voltage license.
 2. PROOF OF EXPERIENCE: Proof (written documentation) that the low voltage Contractor has been regularly engaged in the business of low voltage contracting consisting of, but not limited to, engineering, fabrication, installation, and servicing of communication systems of the type specified herein for at least the past five (5) consecutive years.
 3. PENDING LITIGATION: Provide a statement summarizing any pending litigation involving any officer or principal of/or the company, the nature of

the litigation and what effect the litigation may carry as it relates to this work in the worst-case scenario. Non-disclosure of this item, if later discovered, may result, at the Owner's discretion, in the Contractor bearing all costs and any cost related to associated delays in the progress of the work.

4. **INSURANCE CERTIFICATES:** Copy of low voltage Contractor's current liability insurance and state industrial insurance certificates in conformance with the contract documents.
5. **PROJECT LIST:** A List containing at least ten (10) California installations completed within the last five (5) years by the low voltage Contractor that are comparable in scope and nature to that specified in the contract document.

Contractor must include up-to-date contact information for each project listed including contact name, title, email address and phone number.

6. **SERVICE CAPABILITY:** Documentation indicating in detail that the low voltage Contractor has competent engineering, installation, service personnel and facilities with reasonable stock of service parts within 75 air-miles of the job site. Do not submit a Contractor's company sales brochure as documentation.
7. **AUTHORIZATION LETTERS:** Letters from the low voltage equipment manufacturer stating that the low voltage bidding Contractor is a Factory Authorized Distributor/Installer, and is trained and certified for the equipment he proposes to use on this project, and is licensed to purchase and install software required to provide the specified functions.
8. **CERTIFICATION:** Copy of the following current BICSI certifications. Provide proof that the certificate holders are full time employees of the low voltage Contractor's local facility servicing this project and will be actively involved on site for the duration of this project.
 - a) **BICSI RCDD,** minimum of (1). Mandatory requirement: Shall be on site a minimum of one (1) day per workweek.
 - b) **BICSI TECHNICIAN,** minimum of (2). Mandatory requirement: Shall be on site a minimum of five (5) full 8-hour days perworkweek.
9. **PROOF OF TRAINED PERSONNEL:** Documentation that the Contractor has full time on-staff personnel, manufacturer trained and BICSI certified, for the equipment proposed for this project, and on-staff manufacturer trained and certified by the Test Equipment manufacturer in the proper use of the test equipment required on this project. Provide copies of all manufacturers' training/certification documentation, and Test Equipment manufacturer's training/certification documentation. Provide a statement that personnel meeting these qualifications are in the local facility, and will be maintained at that facility throughout the project and the warranty period.
- d. The THIRD section shall contain a detailed and complete Bill of Materials including the product description, part number and manufacturer name, quantity, unit of measure, and corresponding specification section number or drawing sheet number where that product is referenced. Also listed in the Bill

of Materials shall be test equipment to be used to test the optical fiber, copper, and coax components. Include all patch cords and other specialized components.

See example format below:

Description	Part #	Quantity	UoM	Spec	Test Equip.
Cat-6 Station cable	Belden #12345	10 boxes	1000ft/box	2.03	Fluke DTX-1800

This information may be used by the Owner to evaluate the Contractor's general understanding of the project scope during the bid evaluation. Errors/Omissions from this Bill of Materials does not relieve the Contractor from providing all material, components, labor, etc., as outlined in this document and on the drawings to provide a complete and fully functional system(s).

- e. The FOURTH section shall contain original manufacturer cut sheets for all of the materials that meet the requirements listed in Section 2 of this document, and all materials described on the construction drawings. Also include manufacturer's cut sheets for all testing equipment to be used for completion of the project. All pages shall be numbered sequentially corresponding to the bill of materials list. On each cut-sheet, provide an indicating arrow next to each part number of proposed material.
- f. The FIFTH section shall contain a designation schedule for each system component location, and complete "E" size (30" x 42") (unless otherwise specified) bond drawings, showing system wiring plans. The professionally drafted drawings shall be generated on AutoDesk AutoCAD 2004 or later computer design software. These drawings shall also include:
 - 1) MDF and IDF Diagrams - Including:
 - a) Cable routing, conduit sleeve(s) locations, sizes and fill count
 - b) Floor plan identifying locations of all components and apparatus
 - c) Detailed layout and elevations of the wall field(s)
 - d) Labeling plan
 - 2) Site Plan – Including:
 - a) Conduit quantity, sizes and routing of all site conduits including in-ground vaults, pull boxes, and manholes, including labeling plan.
 - b) Building designations
 - c) MDF and IDF locations and labeling in each building
 - d) Cabling type and quantity between MDF and each IDF location
 - 3) Work Area Floor Plans - Including:

- a) Detailed cable routes, including quantity of cables.
 - b) Device locations and quantities
 - c) Approved labeling plan for all work area outlets, cabling, and devices.
 - 4) Cross Connect Documentation - Including:
 - a) Cross-connect records for all voice, data, speaker, clock and IP camera devices. Provide in Excel format.
 - 5) Riser Distribution Plan
 - 6) Rack elevations of all MDF and IDF equipment properly labeled
 - 7) 1/4-inch scale floor plans of all MDF and I DF data rooms identifying all equipment properly labeled.
 - 8) Cable Tray, Conduit, and Raceway Plans (if applicable) with quantities, cable type and cable quantity for each.
 - 9) Campus Distribution Plan (if applicable)
- B. Failure to comply with any of the requirements listed above may result in the rejection of the entire submittal package.

1.7 PROJECT DIRECTION

- A. Single Point of Contact: Contractor will provide an English proficient, single point of contact, i.e., Project Manager, to speak for the Contractor and to provide the following functions:
- 1. Initiate and coordinate tasks with Owner's Project Manager, and others as specified by Owner's Project Manager.
 - 2. Provide day-to-day direction and on-site supervision of Contractor personnel.
 - 3. Shall be readily available to the Owner/Owner's Project Manager 24 hours a day / 7 days a week throughout the duration of the Project.
 - 4. Shall have full time cellular phone capability, and the ability to send/receive email correspondence, accessible by the Owner's Project Manager.
 - 5. Ensure conformance with all Contract provisions.
 - 6. Participate in weekly site project meetings and construction meetings.
 - 7. Provide detailed and written weekly status reports to Owner's Project Manager. The content shall be substantive enough to bring about a full understanding of all situations current and situations future. Weekly reports shall include but are not limited to detailed Weekly Progress Report, RFI status log (Request for Information), Change Order Log (pending and approved), Project Addendum Log. Each of the above must show assigned responsibilities and event history. Weekly reports shall include milestone information, resource updates (staff and materials),

and any conditions or incidents that may impact the Project Schedule. Contractor shall provide hard copies to Owner.

8. This individual will remain as Project Manager for the duration of the project. The Contractor may change Project Managers only with the Owner's Project Manager's written approval.

1.8 PLANNING

- A. Planning meetings and schedule: Within fifteen (15) calendar days after the date of award of the Contract, an initial planning meeting will be held with the successful bidder to clarify all requirements (systems, services, distribution methods, etc.), identify responsibilities, and schedule the events that will transpire during the implementation of the project. Within seven (7) calendar days of this initial meeting, the Contractor shall provide a written report and project schedule to clearly document the events and responsibilities associated with the project. Contractor's project schedule shall conform to the overall Project Construction Schedule issued by the Construction Management Company or the Owner. Contractor is required to attend all planning and other construction meetings as requested by the Owner, Architect, or Engineer.

1.9 POST INSTALLATION SUBMITTAL REQUIREMENTS

- A. Within fifteen (15) calendar days after the completion of work, the Contractor shall submit the following:
 1. Record Documentation:
 - a. Final Test Results – Test results for each cable indicating tests performed, results obtained and values measured. Test results shall be provided in electronic format (CD) with the associated application (if required) for viewing. Testing shall be conducted in accordance with Section 3.09 of this document.
 - b. As-Built Drawings – Contractor shall provide two (2) complete sets of professionally drafted "E" size (30" x 42"), unless otherwise noted, reproducible bond as-built drawings, generated on AutoDesk AutoCAD 2004 or later. Contractor shall provide/create all backgrounds, site plan and floor plans. Borders shall be Contractor-provided or Architect provided. All borders shall be reviewed by Owner or Architect prior to acceptance by Owner.
 - 1) MDF and IDF Diagrams including:
 - a) Cable routing, conduit sleeve(s) locations, sizes and fill count
 - b) Floor plan identifying locations of all components and apparatus
 - c) Detailed layout and elevations of the wall field(s)
 - d) Labeling plan
 - 2) Site Plan – Including:
 - a) Conduit quantity, sizes and routing of all site conduits including in-ground vaults, pull boxes, and manholes, including labeling plan.

- b) Building designations
 - c) MDF and IDF locations and labeling in each building
 - d) Cabling type and quantity between MDF and each IDF location
 - 3) Work Area Floor Plans - Including:
 - a) Detailed cable routes, including quantity of cables.
 - b) Device locations and quantities
 - c) Approved labeling plan for all work area outlets, cabling, and devices.
 - 4) Cross Connect Documentation - Including:
 - a) Cross-connect records for all voice, data, speaker, clock and IP camera devices. Provide in Excel format.
 - 5) Riser Distribution Plan
 - 6) Rack elevations of all MDF and IDF equipment properly labeled
 - 7) 1/4-inch scale floor plans of all MDF and I DF data rooms identifying all equipment properly labeled.
 - 8) Cable Tray, Conduit, and Raceway Plans (if applicable) with quantities, cable type and cable quantity for each.
 - 9) Campus Distribution Plan (if applicable)
- B. Contractor shall provide to Owner two (2) sets of CDs containing all post-installation submittals and close-out documentation.
- C. As-Built Documentation Display In Each MDF and IDF: Within fifteen (15) days after the completion of work, the Contractor shall install a c complete Contractor-provided, professionally drafted as-built floor plan in each MDF and IDF. These documents shall be mounted in a suitably-sized frame containing a Plexiglas cover. Each floor plan, generated on AutoDesk AutoCAD 2004, or later, computer design software and printed in color. Size of plans displayed shall be full size, or at the discretion of the District, half- size. The plans shall depict all jack locations in each classroom, office, and all other areas. Also depicted shall be speaker, clock, wireless access point, terminal cabinets, MDF, IDF, pull boxes, vaults, cameras, television jack locations, or any other communications outlet cable installed by the Contractor. All jack locations shall be color- coordinated with the Owner's labeling scheme as described elsewhere in this specification.
- D. Warranty Documentation:
- 1. Contractor shall apply for all Manufacturers' Extended Warranties on behalf of the Owner. Contractor shall present to Owner all General and Specific Warranty Documents per Warranty Specifications Sections. Warranty shall commence after final acceptance of System and Project close-out by the Owner.

1.10 GENERAL SYSTEM PRODUCT, INSTALLATION AND OVERALL SYSTEM WARRANTY

- A. A twenty-five (25) year Extended Product Warranty and Application Assurance for the Voice/Data/Intercom-Clock/CCTV wiring systems shall be provided as follows:
1. 25 Year Extended Product Warranty
 - a. The 25 Year Extended Product Warranty shall ensure against product defects, that all approved cabling components exceed the specifications of ANSI/TIA/EIA 568-B and ISO/IEC 11801, exceed the attenuation and NEXT requirements of ANSI/TIA/EIA 568-B and ISO/IEC 11801 for cabling channels, that the installation will exceed the loss and bandwidth requirements of ANSI/TIA/EIA 568-B and ISO/IEC 11801 for fiber channels, for a twenty-five (25) year period. The warranty shall apply to all passive SCS components.
 - b. The 25 Year Extended Product Warranty shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s) for a twenty-five (25) year period.
 2. 25 Year Application Assurance
 - a. The 25 Year Application Assurance shall cover the failure of the wiring system to support the application which it was designed to support, as well as additional application(s) introduced in the future, up to 350Mbps parallel transmission schemes, by recognized standards or user forums that use the ANSI/TIA/EIA 568-B or ISO/IEC 11801 component and channel specifications for cabling, for a twenty-five (25) year period.
 3. System Certification
 - a. Upon successful completion of the installation and subsequent inspection, the Owner's Project Manager shall be provided with a numbered certificate, from the manufacturing company, registering the installation.
- B. Manufacturer Site Certifications are not allowed, regardless of project size.
- C. A fire (5)-year labor and material warranty for the Intercom/PA/Clock system shall be provided.
- D. A three (3)-year labor and material warranty for the CCTV system shall be provided.

1.11 GENERAL ENGINEERING AND DESIGN GUIDELINES

- A. Cabling System Installation Practices
1. Cable tie (tie wrap) devices shall not be utilized at any time. Only Velcro™ -type strap devices are permitted. Velcro™ -type straps are to be utilized in the MDFs and IDF's at a maximum interval of three (3) feet.
 2. All pull rope devices are to be replaced in all pathways with new pull rope or approved pull string, for future use.
 3. All intra-building cabling shall be routed either parallel or at right angles to the building structure and/or walls.

4. All innerduct shall be supported at a maximum of eighteen (18) inch intervals if running vertical and maximum of forty-eight (48) inch intervals if running horizontal.
5. No cabling is to be pulled through electrical Condulet (L-bend) devices. If Condulet devices are pre-existing and it is determined by the review of the District's representative that sufficient space in the conduit is available, the Contractor shall remove the Condulet cover, and pull the cable through the Condulet, then carefully reinstall the cover.
6. Communications cabling shall never be tied to electrical power cables or devices, lighting systems, or co-exist in any pathway with power cabling.
7. Any visible damage to a cable such as kinks or bends in violation of the minimum bend radius shall render the cable segment defective and shall be removed and replaced.
8. All materials shall be new, unused, and delivered to job site in original manufacturer or distributor cartons or packages. No previously installed material shall be used at any time.

B. Equipment Room – Main Distribution Frame (MDF)

1. Site Selection: Careful consideration is required in the selection of the ideal site for equipment placements. Site selection should comply with all provisions of TIA 569; including the following:
 - a. Floor Loading: If equipment room is not on ground level or a basement, the floor support system should be designed for distribution loading greater than 250 lbs/ft, and a concentrated loading should be greater than 1000 lb/f over the area of the greatest stress to be specified.
 - b. Room Size: An allowance shall be made for non-uniform occupancy throughout the building. Provide 0.75 square feet of equipment room space for every 100 square feet of workstation space, or a minimum of 150 square feet, whichever is greater.
 - c. Water Infiltration: The equipment room shall be free of water. No plumbing or waste pipes shall enter or pass through the equipment room.
 - d. Environmental Requirements: The equipment room should be provided with temperature control equipment (HVAC) to maintain the temperature inside the room between 64-75 degrees Fahrenheit, while the equipment is operating.
 - e. Power Requirements: A separate power supply serving the equipment room shall be provided and terminating at its own electrical panel.

C. Special Design Cases-IDF to Adjacent Buildings

1. In the event that a building with minor data needs is located nearby another building that contains an Intermediate Distribution Frame room (IDF), connectivity may be provided as if it were a horizontal run from the IDF to the adjacent building, if the following conditions are met. The total installed cable length from the IDF to the jacks in the adjacent building must be less than 295 feet (90 meters).

Category-6 cable shall be used. This should be done while maintaining the minimum 25-year manufacturer's warranty. Utilize outside plant rated cable when installed in underground conduit. Cable shall not be installed aerially between above-ground poles or other structures.

D. Typical User Requirements

1. Typical Main Distribution Frame (MDF)

Each individual Riverside school shall have (1) one MDF location, which is usually located in the Administration office. All backbone data cables will be terminated at the MDF location. A free standing, 7-foot high, two or four post racks, enclosed 7-foot racks, or 7-foot locking cabinets will be used, the decision as to which one will be at the discretion of the District and will be clearly identified as part of the project scope documentation. A telecommunications main ground bus bar (TMGB) connection is required in the MDF room with connection to each rack or cabinet utilizing a minimum #6 AWG green conductor. See Section 2.13 of this document for additional grounding requirements.

2. Typical Intermediate Distribution Frame (IDF)-Data system

Each individual building shall have a minimum of (1) one IDF location. The IDF location will be determined by the District, after considering various environmental and functional factors. A properly sized locking cabinet shall be used. In special cases, and when specifically authorized by the District, a building with only minor data requirements will not be provided with its own IDF. If such buildings are less than 295-feet (total cable length) from the building with an IDF, a Category-6 cable will be used to provide connectivity from the IDF. Cabinets shall be grounded in accordance with Section 2.13 of this document.

E. Typical Classroom

A typical classroom installation will use Category-6 cable from patch panel located in the IDF to duplex or quad surface mounted outlets in the classroom. The center of the receptacle outlets shall be installed not less than 18 inches above the floor or working platform, to comply with Article 210 of the Americans with Disabilities Act.

1. Classroom data (1 data in 3 teacher drop locations).

- a. A teacher drop location shall consist of 1 surface mounted data outlet in a single gang faceplate. Three teacher drop locations shall be installed in each classroom in the corner except for by the door.
- b. Each outlet shall be cabled with Category-6 cable terminating to a Category-6 modular jack. Each jack will be Category-6 RJ-45 with a 110-termination using the 568B wiring scheme.

2. Classroom 4 data (student drops). Adjustments to this number may be made at the discretion of the District.

- a. Provide 2 drops below the marker board, and 2 drops on the wall opposite the marker board.
- b. Each outlet shall be cabled with Category-6 cable terminating to a Category-6 modular jack. Each jack will be Category-6 RJ-45 with a 110-termination using the 568 wiring scheme.

3. Classroom additional drops.
 - a. Provide 1 drop (cable, jack and faceplate) on the back wall of the classroom.
This is to power an I.P. clock/speaker.
 - b. Jack to be above ceiling or at ceiling line where clock is to be placed.
 - c. Retrofit cable 6' length above ceiling with plug connection. Wire plugs directly to speaker board – no box.
4. One (1) wireless access point, ceiling mounted in the center of the room below the T-bar grid, shall be provided in each classroom.
5. Surface Mounted Raceways
 - a. In existing structures, or where called out on the plan documents, Wiremold 2300 or 5400-series surface mounted raceway system shall be used for surface-mount applications.
 - b. In new construction projects, surface mounted raceway shall not be utilized unless specifically called out on the plan documents and approved by the Owner's project engineer.
 - c. Wiremold raceway shall be properly fastened into wall studs at intervals not to exceed 16-inches in horizontal runs and 2 feet in vertical runs. Wiremold must be mounted flush to the wall with no visible gap between the Wiremold and wall.
 - d. The voice/data cabling shall occupy one channel only of the two-channel system.
 - e. Wiremold raceway shall be installed to the station outlets branching off the main cable routes or separate runs shall be installed to individual outlets as required. At no time shall the raceway fill rate exceed 40 percent.
 - f. Each Wiremold raceway run shall include the appropriate cover and utilize cover clips to hide seams between cover sections.
 - g. Each vertical Wiremold raceway run that penetrates a ceiling shall include an entrance end fitting with cover. Ceiling fittings shall be installed so that it is in direct contact with the ceiling, without any gaps between ceiling and fitting cover. Ceiling openings shall be neatly and squarely trimmed by the Contractor to the satisfaction of the District.
 - h. In order to meet and exceed all current and future cable bend radius requirements, Contractor shall only install Wiremold radiused "FO"-type elbows and tee fittings.
- F. Typical Office: A typical office will be cabled with Category-6 cable from a patch panel to a duplex surface mounted outlet, which is provided for each faculty personnel. The kitchen office and library reception areas are included as typical offices; the library reception consists of two work stations.
 1. Principal's Office
 - a. Drop locations shall consist of 2 duplex surface mounted data outlets in a single gang faceplate. Provide one drop on each wall.

- b. Each outlet shall be cabled with Category-6 cable, terminating to a Category-6 modular jack. Each jack will be a Category-6 RJ-45 with a 110 termination using T568B wiring scheme.
 - c. Fill all unused faceplate ports with a blank insert matching the color of the faceplate.
- 2. Office 1 Data drops (faculty drop)
 - a. Drop locations shall consist of 2 duplex surface mounted data outlets in a single gang faceplate on each wall.
 - b. Each outlet shall be cabled with Category-6 cables terminating to a Category-6 modular jack. Each jack will be Category-6 RJ-45 with a 110 termination using T568B wiring scheme.
 - c. Fill all unused faceplate ports with a blank insert matching the color of the faceplate.
- 3. Administration Reception Area
 - a. A wireless access point (WAP) shall be provided for visitors in the reception area.
- 4. Surface Mounted Raceways
 - a. In existing structures, or where called out on the plan documents, Wiremold 2300 or 5400-series surface mounted raceway system shall be used for surface mount applications.
 - b. In new construction projects, surface mounted raceway shall not be utilized unless specifically called out on the plan documents and approved by the Owner's project engineer.
 - c. Wiremold shall be properly fastened into wall studs at intervals not to exceed 16- inches in horizontal runs and 2 feet in vertical runs. Wiremold must be mounted flush to the wall with no visible gap between the Wiremold and wall.
 - d. The voice/data cabling shall occupy one channel only of the two-channel system.
 - e. Wiremold raceway shall be installed to the station outlets branching off the main cable routes or separate runs shall be installed to individual outlets as required. At no time shall the raceway fill rate exceed 40 percent.
 - f. Each Wiremold raceway run shall include the appropriate cover and utilize cover clips to hide seams between cover sections.
 - g. Each vertical Wiremold raceway run that penetrates a ceiling shall include an entrance end fitting with cover. Ceiling fittings shall be installed so that it is in direct contact with the ceiling, without any gaps between ceiling and fitting cover. Ceiling openings shall be neatly and squarely trimmed by the Contractor to the satisfaction of the District.
 - h. In order to meet and exceed all current and future cable bend radius

requirements, Contractor shall only install Wiremold radiused "FO"-type elbows and tee fittings.

1.12 SPECIFIC SYSTEM REQUIREMENTS

A. Backbone Infrastructure Cabling – Data

1. Backbone Fiber Optic Cabling

- a. For distances up to 1800 feet (550 meters), the Contractor shall provide one (1) OM4 12-strand multimode fiber optic cable for backbone connectivity between the MDF and each IDF. For cabling to isolated structures with limited data needs, such as a concession stand, 4-strand OM4 multimode fiber optic cable may be considered.
- b. For distances greater than 1800 feet (550 meters), the Contractor shall provide one (1) 12-strand single mode fiber optic cable for backbone connectivity between the MDF and each IDF.
- c. At the MDF, provide a 20-foot slack loop neatly coiled, labeled and secured. At each IDF, provide a 10-foot slack loop neatly coiled, labeled and secured.
- d. Splicing of fiber optic cable shall not be permitted.
- e. All exposed fiber optic cable shall be enclosed in inner-duct. Inner-duct is not required within dedicated inter-building conduits.
- f. Provide 1-meter and 2 -meter fiber optic patch cords for each pair of strands terminated at the MDF and each IDF.
- g. See Part 2 of this document for fiber optic cable specifications.

2. MDF/IDF UTP Termination Equipment

- a. The horizontal cross-connect for data circuits shall consist of patch cords from the horizontal Category-6 termination panels to the network equipment within the same or adjacent racks.
- b. The MDF horizontal data cross-connect shall be contained in 19"x 7' rack(s) or free standing lockable cabinet, the IDF shall be terminated in a appropriately sized locking cabinet or equivalent as described in Part 2 of this document.
- c. 2-post and 4-post open racks shall be installed with vertical wire management on each side. Patch panels shall be 24 or 48 modular jack ports, wired to T568B, with 1U horizontal wire management immediately below each patch panel.
- d. Category-6 patch cords and drop cords shall be provided by Contractor. Provide one (1) 3-foot cord or 7-foot cord for the MDF/IDF and one (1) 14-foot cord for each outlet jack port. In instances where longer cords are required, the Contractor is to clarify the requirement with the District before installing any longer cords.
- e. See Part 2 of this document for cable specifications.

2. PART 2 - PRODUCTS

2.1 STRUCTURED CABLING SYSTEM

- A. Acceptable Manufacturers - all equipment listed herein will be by:
 - 1. SCS components: Leviton eXtreme 6+ cat-6 UTP System with BerkTek Lanmark 1000 cable, Belden System 3600, or Equal.
 - 2. Cabinets, Racks, Wire Management, and Ladder tray: Chatsworth, Encore, Southwest Data Products, or UL Listed and approved equal.
 - 3. Riser and Outside Plant (OSP) Fiber Cable: Belden, AMP, or Superior Essex.
 - 4. Riser and OSP Copper Cable: Belden, AMP or Superior Essex.
 - 5. Protectors: Circa, Emerson, or Marconi.
- B. It is the responsibility of the bidder to insure that the proposed product meets or exceeds every standard set forth in these specifications and the equipment's technical data sheets.
- C. The functions and features specified are vital to the operation of this facility; therefore, inclusion of a component's manufacturer in the list of acceptable manufacturers does not release the Contractor from strict compliance with the requirements of this specification.
- D. See Quality Assurance section of this specification for additional product substitution requirements.

2.2 OUTLETS

- A. Faceplates
 - 1. All Faceplates shall be available in single, duplex, triplex, quad, or six-plex arrangement in a single gang configuration.
 - 2. Faceplates shall be available in eight-plex arrangement in a dual gang box configuration.
 - 3. Surface mount boxes shall be available in single, dual, quad, and six-plex configuration.
 - 4. Modular furniture faceplates shall be available in single, dual, triple and quad configuration for the Owner's modular existing and/or new modular furniture. Faceplates shall be flush-mounted in the modular furniture. Surface mounted boxes/faceplates are unacceptable. The Contractor is responsible for coordinating with the Owner's modular furniture Contractor to determine faceplate requirements. The Contractor shall provide and install all parts/fittings necessary to meet the requirements of this section.
 - 5. Wall mounted phone jack faceplates shall be single gang configuration, constructed of stainless steel and have two standard phone mounting posts

located above and below the jack opening. Wall mounted phone faceplates will consist of 8p8c modular (RJ-45) jacks.

6. Faceplates shall have designation windows with clear plastic covers.
- B. Communications outlets shall consist of one, two or three gang utility outlet boxes plates equipped with 8-pin modular (RJ-45) jacks utilizing T568B wiring scheme. All outlet cabling shall terminate on termination blocks at their associated Main Distribution Frame (MDF) room, Intermediate Distribution Frame (IDF) Rooms, or as otherwise indicated on the drawings.
- C. Unless otherwise noted on the floor plans, or within this document, all data wall outlets for 23- AWG copper cable shall be:
 1. 8-position/8-conductor (8p8c) modular outlets for data and for voice.
 2. Insulation displacement.
 3. Support universal applications in a multi-vendor environment, accepting modular RJ- 45 plugs for data outlets and for voice outlets.
 4. Provide with blank module inserts for all unused module locations. Jack module arrangement is shown on the drawings. Provide color-coded inserts at each outlet, termination block and at patch panels.
- D. Category-6 Gigabit outlets
 1. All Category-6 outlets shall meet or exceed Category-6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA 568-C Commercial Building Telecommunications Cabling Standard and be part of the UL LAN Certification and Follow-up Program.
 2. The Category-6 outlets shall be capable of being in a modular patching situation or as a modular telecommunication outlet (TO) supporting current 10Base-T, Token Ring, 100 Mbps TP-PMD, 155 Mbps ATM, 622 Mbps ATM using parallel transmission schemes and evolving high-speed, high-bandwidth applications, including Ethernet, 1000BASE-T and 1.2 Gbps ATM.
- E. Product Specification: Leviton, Belden or equal.

2.3 STATION CABLE

- A. Category-6 UTP cables shall extend between the station location and its associated TC and consist of 4-pair, 23-AWG, unshielded, twisted pairs, and shall terminate on 8 - position modular jacks provided at each outlet.
- B. Category-6 UTP, 4 Pair
 1. The high performance Category-6 UTP cable shall be of the traditional round shape with a central spine design to maintain stable pair position.
 2. The cable jacket shall comply with Article 800 N EC and labeled CMP for use as a plenum cable when installed in plenum-rated spaces, and labeled CMR when

installed in riser-rated and non plenum-return spaces. CMP and CMR cable shall not be installed in underground conduit unless it includes an outdoor wet-location rating.

- C. All Category-6 high performance cables shall meet or exceed the

following: Electrical Characteristics:

DC Resistance Max	7.7 (Ohms/100m @ 20°C max)
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Physical specifications:

	Non – Plenum	Plenum
Conductor size	23AWG	23AWG
Diameter	.235" nominal	.23" nominal
Weight/1000ft	27 lbs.	32 lbs.

Guaranteed Electrical Performance Requirements (dB/100M):

Freq MHz	Insertion Loss Max.	Min. PSNEXT	Min. PSACR	Min. Return Loss
10.0	5.8	62.3	56.5	25.0
16.0	7.4	59.2	51.9	25.0
25.0	9.3	56.3	47.1	25.0
62.5	15.0	50.4	35.4	25.0
100.0	19.3	47.3	28.0	25.0
200.0	28.3	42.8	14.5	21.6
250.0	32.1	41.3	9.2	20.5
300.0	35.6	40.1	4.5	20.1

Freq MHz	Min. Bal. TCL	Min. Bal. ELTCTL		
10.0	42.0	17.0		
16.0	40.0	12.9		
25.0	38.0	9.0		
62.5	34.0	--		
100.0	32.0	--		
200.0	29.0	--		
250.0	28.0	--		
300.0	--	--		

- D. Product Specification: Belden, BerkTek, orequal.

2.4 MODULAR PATCH PANEL SYSTEM

- A. The termination block shall support the appropriate emerging high-bandwidth applications, including 1 Gbps Ethernet, potentially 1.2 Gbps ATM and 2. 4 Gbps ATM, Multi-Tasked Split Screen Computing, Virtual Holographic Video Conferencing, Instant Access Telemedicine, 3D CAD/CAM Engineering, and Internet-Intranet Communications/ Commerce, as well as all 77 channels (550 MHz) of analog broad band video, including 1000 Mbps Ethernet and potentially 1.2 Gbps ATM, and facilitate cross connection and inter connection using modular patchcords.
- B. All Modular jack panels shall be wired to ANSI/TIA/EIA 568-C using T568B wiring scheme.

- C. The wiring block shall be able to accommodate 23 AWG cable conductors.
- D. The Category-6 modular jack panels shall meet or exceed the Category-6 standards requirements in ISO/IEC 11801 and ANSI/TIA/EIA and shall be UL Listed.
- E. A 110-IDC termination block shall provide for the termination of horizontal, equipment, or tie cables.
- F. All patch panels shall have two (2) cable strain relief/management bars (Leviton #49005- CMB or equal) installed at the rear of the panel to support the terminated horizontal cabling.
- G. Each patch panel shall have one horizontal wire manager installed above and below.
- H. Product Specification: Belden, Leviton or equal.

2.5 CATEGORY-6 – PATCH/STATION CORDS

- A. Provide Category-6 Modular Patch/Station cords for each assigned port on the patch panel and for each outlet in the station locations. All cords shall conform to the requirements of ANSI/TIA/EIA 568-C Standard, Horizontal Cabling Section. Cords shall be equipped with an 8-pin 8-conductor modular connector on each end and shall conform to the length(s) specified. All cords shall be wired to T568B standards. All cords shall be factory-built by the station cabling manufacturer. Fabrication of cords in the field is prohibited.
- B. All patch cords shall exceed ANSI/TIA/EIA and ISO/IEC Category-6/Class E specifications. Patch cords shall be available in stranded and solid conductor in lengths to twenty (20) feet.
- C. The patch cord shall have built-in exclusion features to prevent accidental polarity reversals and split pairs.
- D. UL Verified for ANSI/TIA/EIA 568-C Electrical Performance
- E. Miscellaneous:
 - 1. UL Listed for Fire Safety
 - 2. ISO 9001 Certified Manufacturer
- F. Product Specification: Belden, Leviton, or equal.

2.6 FIBER OPTIC CABLING

- A. OM4, Laser optimized, extended distance fibers with 50 micron cores only.
- B. Fibers must comply with ANSI/TIA/EIA 492 specifications and ISO/IEC 11801 standards.
- C. Fibers will have dual wavelength capability; transmitting at 850 and 1300nm ranges.
- D. Shall be designed to support 10Gb/s applications up to 1800 feet (550 meters).

- E. Specifications.
- F. Maximum attenuation @ 850/1300 nm: 2.8/1.0 dB/KM.
- G. 550 Meter laser bandwidth 2200 MHz-km @850 nm, 500 MHz-km @1300 nm
- H. All fiber in a cable run shall be from the same manufacturer and shall be the same type. A mix of fibers from different manufacturers may not be used.
- I. Loose tube cables shall be gel free. Tight buffered cables shall be gel free, riser rated, and plenum rated when installed in a plenum rated environment.
- J. Product Specification:
 - 1. Outside Plant Cables: Belden, BerkTek or equal. Provide fan-out kits as required.
 - 2. Building Cables: Plenum-Rated (installed inside plenum innerduct), Belden, BerkTek or equal.

Core	50 μ m
Performance	Laser optimized 10 Gigabit to 550 meters
Numerical Aperture:	0.200 \pm 0.015
Cladding diameter:	125 μ m \pm 1 μ m
Colored Fiber Diameter:	250 μ m \pm 15 μ m
Minimum Tensile Strength:	100,000 psi
Fiber Minimum Bending Radius:	.75 in. (1.91 cm)
Cable Minimum Bending Radius:	
During Installation:	20 times cable diameter
After Installation:	10 times cable diameter
Operating Temp. Range:	32°F to 122°F (0°C to 50°C)
Storage Temp. Range:	-40°F to 149°F (-40°C to 65°C)
Maximum Fiber Loss (attenuation):	2.8 dB/km at 850 NM 1.0 dB/km at 1300
Minimum Bandwidth:	1500 MHz-km OFL BW at 850 NM 500 MHz-km OFL BW at 1300 NM 2000 MHz-km EMB at 850NM

- K. Single Mode Fiber specifications:
 - 1. Fibers must comply with ANSI/TIA/EIA 492 specifications and I SO/IEC 11801 standards.
 - 2. All fiber shall be color coded to facilitate individual fiber identification.
 - 3. Fiber will have coating to ensure color retention, minimize microbending losses and improve handling. The coating shall be mechanically strippable.
 - 4. Loose tube cables shall be gel free. Tight buffered cables shall be gel free, riser rated, and plenum rated when installed in a plenum rated environment.

Fiber Attribute	Depressed Cladding	Matched Cladding
Cladding Diameter	125.0 μ 1.0 μ m	125.0 μ 1.0 μ m

Cladding Non-Circularity	□ 1.0%	□ 1.0%
Colored Fiber Diameter	250 □ 15 □m	250 □ 15 □m
Core Diameter	8.3 □m	8.3 □m
Index of Refraction	0.37%	0.33%
Core/Cladding Concentricity	□0.8 □m	□0.8 □m
Mode Field Diameter	8.8 □ 0.5 □m @ 1310 NM	9.3 □ 0.5 □m @ 1310 NM
Minimum Proof Strength	100,000 psi	100,000 psi
Maximum Attenuation	.40 dB/km @ 1310 NM .30 dB/km @ 1550 NM	.40 dB/km @ 1310 NM .30 dB/km @ 1550 NM
Maximum Dispersion	2.8 ps/NM-km 1285 to 1330 NM	3.5 ps/NM-km 1285 to 1330 NM
Fiber Cutoff Wavelength	□1130 NM. □1300 NM	□1150 NM. □1350 NM
Fiber Macrobend (100 turns @ 32 mm diameter)	□0.05 dB @ 1310 NM □0.10 dB @ 1550 NM	□0.05 dB @ 1310 NM □0.10 dB @ 1550 NM
Coating Strip Force	1.3 N □ F □ 8.9 N	1.3 N □ F □ 8.9 N

Fiber Attribute	True Wave
Cladding Diameter	125.0 □ 1.0 □m
Cladding Non-Circularity	□ 1.0%
Colored Fiber Diameter	250 □ 15 □m
Core Diameter	8.3 □m
Index of Refraction	0.33%
Core/Cladding Concentricity	□0.8 □m
Mode Field Diameter	8.4 □ 0.6 □m @ 1550 NM
Dynamic Fatigue Parameter (nd)	□ 20
Static Fatigue Parameter (ns)	□ 20
Fiber Curl	□ 2 meters
Macrobend (1 turn, 32 mm dia.)	□ 0.5 dB at 1550 NM
Minimum Proof Strength	100,000 psi
Maximum Attenuation	.40 dB/km @ 1310 NM .30 dB/km @ 1550 NM
Zero Dispersion Wavelength	Not Applicable
Dispersion Slope	Not Applicable
Dispersion (Absolute)	1.0 to 5.0 ps/NM-km from 1550nm to 1565nm
Fiber Cutoff Wavelength	□1150 NM. □1350 NM
Cbl. Cutoff Wavelength	□ 1260 NM
Fiber Macrobend (100 turns @ 32 mm diameter)	□0.05 dB @ 1310 NM □0.10 dB @ 1550 NM
Coating Strip Force	1.3 N □ F □ 8.9 N

L. Product Specification:

1. Outside Plant Cables: Belden, BerkTek or equal, Single mode with buffer/fan-out kits as required.
2. Building Cables: Belden, BerkTek or equal.

2.7 FIBER PATCH CORDS

- A. Fiber patch Cords shall be available in either Singlemode or Multimode.

- B. Construction shall be either 3.0 mm cordage or 1.6mm cordage.
- C. Connectors shall be available in Duplex LC or MTRJ.
- D. The 50-micron multimode fiber optic solution and single mode fiber optic solution shall utilize factory-made patch cords.
- E. Product Specification: Leviton, Belden or equal.

2.8 FIBER DISTRIBUTION CENTER (FDC)/FIBER PATCH PANEL

- A. Fiber Patch Panels - Combination Shelf: The Combination Shelf is a wall or frame mounted unit that terminates, provides cross connection, interconnection, splicing and fiber identification for up to 48 fiber strands. The shelf will provide protection from mechanical stress on the cable and fibers and from macro-bending losses.
 - 1. The shelf shall be wall or rack mountable depending on the location requirement. The units must fit into a 19" wide frame arrangement and have a jumper routing trough.
 - 2. When wall mounted the shelf shall consist of a modular enclosure with front access and can be fully administered from the front. When rack mounted the shelf shall consist of a modular enclosure with front and rear access and can be fully administered from the front and rear. The unit shall slide out to allow access from the top. Include splice organizers and fiber breakout kits as required.
 - 3. The shelf shall have a translucent, removable cover over the connector panels. The connector panels shall snap into the front of the shelf and accommodate LC, or MTRJ connectors as required.
 - 4. Miscellaneous:
 - a. UL Listed for Fire Safety
 - b. ISO 9001 Certified Manufacturer
 - 5. Fiber patch panel/shelf shall be labeled according to the Owner's specific requirements.
 - 6. Product Specification: Leviton, Belden or equal.

2.9 FIBER OPTIC CONNECTORS

- A. Fiber Optic Connectors: Provide a field installable singlemode or multimode type connectors to terminate fiber optic cables from cable-to-cable, cable-to-equipment or equipment-to-equipment, and to make jumpers. Fiber connectors shall be LC.
 - 1. The connector must:
 - a. Be field installable.
 - b. Be capable of mounting on either 250 um fiber or 900 um buffered fiber.

- c. Utilize a no-polish and no-epoxy system.
- d. Meet EIA and IEC standards for repeatability.
- e. Typical insertion loss 0.1dB. Maximum insertion loss 0.5dB.
- f. Be available in LC and MTRJ styles.
- g. Connector shall have a factory-polished fiber stub in the ferrule.
- h. Connector shall have a translucent back section allowing the use of a visual fault locator to help determine fiber contact during installation.
- i. Have a locking feature to the coupler and assure non-optical disconnect.
- j. Miscellaneous:
 - 1) UL Listed for Fire Safety
 - 2) ISO 9001 Certified Manufacturer

2. Product Specification: Leviton, Belden or equal.

2.10 COPPER CABLING

A. Outside Plant Copper Cables

1. All voice grade wire and cable placed in the outside environment shall be solid, twisted pair, and multi-conductor. The copper twisted pairs shall have a mutual capacitance at 1kHz of 15.7 nF/1,000 ft. The cable shall be resistant to mechanical damage, lightning or damage from wildlife.
2. The aerial air core cable shall be a self-supporting or lashed cable consisting of plastic-insulated solid conductors covered by a plastic core wrap and surrounded by an inner polyethylene jacket, a corrugated aluminum shield, a corrugated steel wrap and a bonded polyethylene jacket (PASP).
3. The buried or underground cable shall have an aluminum steel polyethylene (ASP) sheath and a core of solid-copper conductors, dual insulated with foam skin and plastic, surrounded by FLEXGEL III filling compound.

B. The multi-pair copper cables shall meet the following specifications:

Physical Specifications:

Gauge	24 AWG
Pair Size	25 to 1,800

Electrical Specifications:

DC Resistance	27.3 Ω /1000 ft (8.96 Ω /100m), maximum
Mutual Capacitance (@ 1kHz)	15.7 nF/1000 ft (5.15 nF/100m) (25 pair), maximum
Impedance	100 Ω (25 pair)

Buried/Underground Cable Attenuation (db/1,000 ft [305m]):	
at 772 kHz	5.6 (25 pair), maximum
at 1.0 MHz	6.4 (25 pair), maximum

Aerial Cable Attenuation (dB/1,000 ft [305m]):	
at 772 kHz	5.9 (25 pair), maximum
at 1.0 MHz	6.7 (25 pair), maximum

1. ISO 9001 Certified Manufacturer: Belden, Superior Essex or equal.

- a. Buried/Underground: CSI ANMW
- b. Aerial: CSI BKMP (self-support), CSI BKMA (lashed), CSI BKMH (lashed)

- C. Copper Riser Cables: Shielded or unshielded 24 AWG multi-pair copper cables shall be used as the vertical riser cables. The cable shall support voice, data and building service applications. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation. The multi-pair copper cables shall be in plenum or riser rated form and placed in conduit as required.

1. Shielded: The shielded cable, 200 pair or more, shall consist of solid-copper conductors insulated with expanded polyethylene covered by a PVC skin, be conformance tested to meet ANSI/TIA/EIA 568-C for Category 3 cables, be UL and Listed as CMR. The core shall be overlaid with a corrugated aluminum sheath, which is adhesively bonded to an outer jacket of PVC plastic to form an ALVYN sheath. The copper riser cable shall meet or exceed the following electrical specifications listed below:

- a. Electrical Specifications:

Average DC Resistance	26.5 Ω /1,000 ft (8.7 Ω /100m), maximum
Average DC Resistance Unbalance	1.7%, maximum
Mutual Capacitance @ 1kHz	16 nF/1000 ft (5.25 nF/100 m), maximum
Capacitance Unbalance (pair to ground)	201pF/1,000 ft (65.94 pF/100m) maximum

- b. Attenuation (dB/100 m [328 ft]):

Frequency	Attenuation (Max.)
01.00 MHz	02.3 dB
04.00 MHz	04.9 dB
10.00 MHz	08.5 dB
16.00 MHz	12 dB

- c. Worst Pair Near-End Crosstalk (NEXT) dB/100 m [328 ft]:

Frequency	Pair-To-Pair NEXT (Max.)
1.0 MHz	13.8 dB
4.0 MHz	11.2 dB
10.0 MHz	10.2 dB
16.0 MHz	09.2 dB

- d. The PVC sheath shall have improved frictional properties, allowing it to be

pulled through conduit without the use of lubricants.

- e. The cable shall be available in 25, 50, 100, 150, 200, 300, 400, 600, 900, 1200, 1500, and 1800 pair counts.

- f. Miscellaneous:

- 1) UL Listed for Fire Safety
- 2) ISO 9001 Certified Manufacturer

- g. Product Specification: Belden, Superior Essex or equal, ARMM-type cable.

2. Non-shielded: The non-shielded non-plenum cable shall consist of 24-AWG solid-copper conductors insulated with color coded PVC, 25 pair cable shall be UL Verified to ANSI/TIA/EIA 568-C for Category 3, 25 to 100 pair shall be conformance tested to meet ANSI/TIA/EIA 568-C for Category 3 cables. The non-shielded cable shall be available in 25, 50, 75 and 100 pair. The copper cable shall meet or exceed the following electrical specifications listed below:

- a. Electrical Specifications:

Maximum DC Resistance	28.6 Ω /1,000 ft (9.4 Ω /100m)
Maximum DC Resistance Unbalanced	5%
Maximum Capacitance Unbalanced (pair to ground)	1,000 pF/1000 ft. (328 pF/m)
Mutual Capacitance @ 1kHz	18 nF/1000 ft (5.9 nF/100 m), maximum

- b. Attenuation (dB/100 m [328 ft.]):

Frequency	Attenuation (Max.)
1.00 MHz	2.3 dB
4.00 MHz	4.9 dB
10.00 MHz	8.5 dB
16.00 MHz	12 dB

- c. Worst Pair Near-End Crosstalk (NEXT) dB/100 m [328 ft]:

Frequency	Pair-To-Pair NEXT (Max.)
1.0 MHz	13.8 dB
4.0 MHz	11.2 dB
10.0 MHz	10.2 dB
16.0 MHz	9.2 dB

- d. Miscellaneous:

- 1) UL Listed for Fire Safety
- 2) ISO 9001 Certified Manufacturer

- e. Product Specification: Belden, Superior Essex or equal, ARMM-type cable.

2.11 VOICE CIRCUIT TERMINATIONS IN THE TELECOMMUNICATIONS CLOSETS

- A. The wiring block shall be 110 -type and support Category 3, 5e and 6 applications and facilitate cross connection and interconnection using either cross connect wire or the appropriate category patchcords.
1. The wiring blocks shall be fire retardant, molded plastic consisting of horizontal index strips for terminating 25 pairs of conductors each. These index strips shall be marked with five colors on the high teeth, separating the tip and ring of each pair, to establish pair location. A series of fanning strips shall be located on each side of the block for dressing the cable pairs terminated on the adjacent index strips.
 2. The wiring blocks shall accommodate 22- through 26-AWG conductors and shall be able to mount directly on wall surfaces either with or without backboards or on a 24" free-standing frame.
 3. Clear label holders with the appropriate colored inserts shall be provided with the wiring blocks. The insert labels shall contain vertical lines spaced on the basis of circuit size (3-, 4-, or 5-pair) and shall not interfere with running, tracing or removing jumper wire/patch cords. Labels shall be color-coded and machine labeled/numbered according to Owner's requirements.
 4. The wiring blocks shall be available in 50, 100, and 300 pair sizes. The 100 and 300 pair wiring blocks shall be available with or without legs. The legs allow the cables to pass behind the wiring block and fan out to each side. The space created by the feet, on each side of the block, allows it to be used as a vertical jumper trough. The 50 pair size is not available with legs and shall be utilized for low pair count and/or depth restrictive situations.
 5. The wiring block shall be able to accommodate over 500 repeated insertions without incurring permanent deformation and it shall pass the reliability test of no more than one contact failure in 10,000 connections.
 6. The 110 wiring blocks shall meet the following specifications:
 - a. Physical Specifications:
 - 1) Height:
 - a) 25/50-Pair – 1.75 in. (4.45 cm)
 - b) 100-Pair – 3.6 in. (9.12 cm)
 - c) 300-Pair, 10.8 in. (27.41 cm)
 - 2) Width:
 - a) With legs: 10.7 in. (27.23 cm)
 - b) Without legs: 8.5 in. (21.60 cm)
 - 3) Depth:
 - a) With legs: 3.2 in. (8.25 cm)

b) Without legs: 1.4 in. (3.60 cm)

4) Electrical Specifications:

a) ANSI/TIA/EIA Category 5e,6

5) For each wiring block shown on the drawings, provide and install 110 type 4-pair or 110 type 5-pair connecting blocks for each horizontal index strip on each wiring block. For example, a 300 pair wiring block serving station cables requires 72 4-pair connecting blocks. A 300 pair wiring block serving riser pairs requires 60 5-pair connecting blocks.

B. Voice MDF/IDF Rooms, or as otherwise indicated on drawings, locations shall be equipped with termination blocks for termination of voice station and host cable pairs. Voice cable blocks shall consist of a minimum 100 pair. All blocks shall be securely fastened to the room backboards or equipment racks – see drawings. Provide all required D-rings, ladder tray or other approved cable guides as required to provide a neat installation. All cables shall terminate in numerical sequence.

2.12 PROTECTORS

- A. All copper circuits shall be provided with protection between each building with an entrance cable protector panel(s). All building-to-building circuits shall be routed through this protector(s). The protector(s) shall be connected with a #6 AWG copper bonding conductor between the protector ground lug and the MDF/IDF ground point.
- B. Plug in Surge Protection Modules shall be provided for each pair terminated on the chassis. Protector module shall be solid-state type unless otherwise noted.
1. 240VDC/300VDC solid-state protector modules shall provide transient and power fault protection for standard telephone line applications. The modules shall be fast acting, self-resetting current limiters to protect against sneak current type faults. These modules shall be UL Listed with integrated test points and Black in color.
 2. 30VDC/75VDC solid-state protector modules shall provide transient and power fault protection for digital and data line applications. The modules shall be fast acting, self-resetting current limiters to protect against sneak current type faults. These modules shall be UL Listed with integrated test points and Red in color.
 3. In the event that protector modules are not called out in the drawings, SCS Contractor shall include all costs in base bid to provide the 75v solid-state modules w/sneak current protection. Confirm module color with Owner's Engineer prior to ordering. In all cases, SCS Contractor is responsible to coordinate appropriate module with Owner prior to ordering material.
- C. Product Specification: Circa, Emerson or Marconi.

2.7 GROUNDING SYSTEM AND CONDUCTORS

- A. The SCS Contractor shall utilize a Telecommunications Bonding Backbone (TBB) as provided by the Electrical Contractor. The SCS Contractor shall terminate TBB cable(s) on SCS Contractor provided ground busbars located at each MDF/IDF Room, or as otherwise indicated on the drawings. Ground busbars shall be ANSI-J-STD-

607-Acompliant and UL Listed. Busbars shall be Chatsworth # 40153-012 (equal by Harger) or as noted on the drawings. Wall mounted cabinets require a horizontal rack busbar (Chatsworth #10610-XXX) equal by Harger). All communication system bonding and grounding shall be in accordance with the ANSI-J-STD-607-A, the NEC and NFPA.

- B. Horizontal cables shall be grounded in compliance with ANSI/NFPA 70 and local requirements and practices.
- C. Horizontal equipment including cross connect frames, patch panels, cable trays, equipment racks, ladder trays, conduits, active telecommunication equipment, test apparatus and equipment shall be bonded to the TBB ground bus bars utilizing a #6-AWG and 2-hole crimp type grounding lugs. All connections shall be bare metal to bare metal using appropriate antioxidant compound. Burndy mechanical-type grounding lugs and terminals are prohibited. Minimize the length and number of bends of the grounding conductors to the busbar. Attachment to every rack and cabinet shall be made by one of the following methods:
 - 1. Wall mounted IDF cabinets- Attach ground conductor's 2-hole compression lug to the rear rail's top holes of the rack, or front rail's top hole of the cabinet, using either two (2) tri-lobular thread-forming screws (not self-tapping or sheet metal screws) or by using two (2) standard bolts with two (2) "Type B" internal-external tooth lock washers per bolt. If thread-forming screws are not used, remove paint at the connection point and use an approved anti-oxidant prior to attaching the ground conductor.
 - 2. Cabinet/Rack ground busbar- Install a dedicated copper horizontal ground busbar strip at the top of the rear rail of the rack and cabinet. Attach ground conductor's 2-hole compression lug to this ground strip using either tri-lobular thread-forming screws (not self-tapping or sheet metal screws) or by using two (2) standard bolts with two (2) "Type B" internal-external tooth lock washers per bolt.
- D. The SCS Contractor shall be responsible for providing an approved ground at all newly installed distribution frames, and/or insuring proper bonding to any existing facilities. The SCS Contractor shall also be responsible for ensuring ground continuity by properly bonding all appropriate cabling, cable sheaths, circuit protectors, closures, cabinets, service boxes, and framework.
- E. SCS Contractor shall label both ends of each grounding conductor as close as practical to the point of termination in a readable position. Ground tag must indicate the location of both ends of the ground conductor (e.g. Rack#1 to TMGB) and tag must include the warning "If this connector or cable is loose or must be removed, please call the District Telecommunications Manager".

2.13 EQUIPMENT RACKS

- A. When shown on drawings, communication closets shall be equipped with floor mounted equipment racks provided by the SCS Contractor to provide termination bays for the multiple cable types in addition to shelves, panels, power strips, etc. The racks shall be made of lightweight aluminum, UL Listed, and include mounting hardware for mounting specified termination equipment to the frame. In addition, the mounting hardware must provide vertical and horizontal wireways for cross-connect wire.
- B. Equipment racks, ladder trays and rack mount accessories shall be Black in color

unless otherwise noted.

- C. Floor mounted open racks shall be secured from the base to the structural floor to prevent movement, and secured to ladder tray sections installed above. Fasteners installed to the structural floor shall be torqued to the "fastener manufacturer's" recommendation. Racks mounted on raised floors shall be seismically braced to the structural floor below the raised floor to the satisfaction of DSA, and all local, state and federal requirements.
- D. All racks shall be individually grounded to the isolated ground busbar (TMGB, TGB) within the equipment room using a 2-hole compression ground lug and #6 jacketed green cable. Ground wire shall be run as straight as possible, with the length kept as short as possible. Ground wire shall be neatly bundled and secured to the rack and ladder tray. Daisy chaining a ground wire between racks or to other components is not allowed.
- E. Product Specification: Chatsworth, Southwest Data Products, or UL listed and approved equal.

2.14 EQUIPMENT CABINETS

- A. When shown on drawings, communication closets shall be equipped with equipment cabinets to house Owner-provided equipment.
- B. Equipment cabinets and accessories shall be Black in color unless otherwise noted.
- C. Floor mounted cabinets shall be secured to the structural floor to prevent movement using manufacturer recommended floor anchor brackets and fasteners. Fasteners installed to the structural floor shall be torqued to the "fastener manufacturer's" recommendation.
- D. Cabinets shall be configured per the Owner's Project Manager's direction.
- E. All cabinets shall be individually grounded to the isolated ground busbar (TMGB, TGB) within the equipment room using a 2-hole compression ground lug and #6 jacketed green cable. Wall mounted cabinets require a horizontal rack busbar (Chatsworth #10610-XXX, equal by Harger) installed at the top position of the front rails. Attach ground lug to this horizontal busbar. Ground wire shall be run as straight as possible, with the length kept as short as possible. Ground wire shall be neatly bundled and secured to the cabinet and ladder tray. Daisy chaining of ground wire between cabinets or to other components is not allowed.
- F. Cabinets mounted on raised floors shall be seismically braced to the structural floor below the raised floor to the satisfaction of DSA and all local, state and federal requirements.
- G. Product Specification: Chatsworth, Southwest Data Products, or UL Listed and approved equal.

2.15 WIRELESS ACCESS POINTS

- A. Acceptable manufacturer's: Aerohive Networks or equivalent fully compatible equipment.

- B. Interior Wireless Access Points shall meet the following requirements:
 - 1. Support 802.11n 3x3 MIMO with 450 Mbps Data Rate per radio
 - 2. Contain (Qty 2) 802.11n radios per access point and support 2.4 GHz and 5 GHz
 - 3. Utilize omni-directional antennas
 - 4. Contain two Gigabit Ethernet uplink ports
 - 5. Provide built-in classroom management controls to enable a teacher to manage wireless access in the classrooms (i.e. on a per classroom basis a teacher can see how many students connected, allow or deny students access to Internet and direct students to specific web pages)
 - 6. Contain ability to route Apple Bonjour traffic between VLANs (i.e. connect iPad on student VLAN1 to AppleTV on teacher VLAN2)
- C. Exterior Wireless Access Points shall meet the following requirements:
 - 1. Support 802.11n 3x3 MIMO with 450 Mbps Data Rate per radio
 - 2. Contain (Qty 2) 802.11n radios per access point and support 2.4 GHz and 5 GHz
 - 3. Utilize omni-directional antennas
 - 4. Contain one Gigabit Ethernet uplink ports
 - 5. Provide built-in classroom management controls to enable a teacher to manage wireless access in the classrooms (i.e. on a per classroom basis a teacher can see how many students connected, allow or deny students access to Internet and direct students to specific web pages)
 - 6. Contain ability to route Apple Bonjour traffic between VLANs (i.e. connect iPad on student VLAN1 to AppleTV on teacher VLAN2)
- D. Wireless access points shall be provided as indicated on drawings provided and per these specifications. Prior to installation, verify exact locations of equipment to be installed with District in field prior to rough-in.

2.16 INTERCOM-PUBLIC ADDRESS-CLOCK SYSTEM

- A. Acceptable Manufacturers:
 - 1. All equipment listed herein will be by:
 - a. Intercom/PA/Clock components: InformaCast, Atlas Sound speaker/clocks.
 - b. UPS: Tripp-Lite Smart UPS
 - c. Ethernet switches: Cisco Catalyst, see system sections for more information.
- B. It is the responsibility of the bidder to insure that the proposed product meets or exceeds every standard set forth in these specifications and the equipment's technical data sheets.
- C. The functions and features specified are vital to the operation of this facility. Therefore, inclusion of a component's manufacturer in the list of acceptable manufacturers does not release the Contractor from strict compliance with the requirements of this specification.
- D. See Quality Assurance section of this specification for additional product substitution requirements.
- E. All structured cabling system components required for the proper operation of this

system, including cabling and connectivity, shall conform to the Structured Cabling System Products listed elsewhere in this document.

F. Equipment

1. Atlas sound I8SCMF wall speaker clocks
2. Atlas sound SEA I8SC enclosure for surface mount applications
3. Atlas sound FEST- I8SC enclosure for flush mount applications
4. Atlas sound IHVP speakers
5. Atlas sound 161ERS enclosure for flush mount applications
6. Atlas sound 161SES enclosure for surface mount applications
7. Cisco catalyst 3560-24PS series PoE switches
8. Patch panels 24-port, see SCS products section
9. Tripp-lite smart ups #smart750rm1u
10. Category-6 cable individually home run for each device
11. All cat 6 cabling shall be certified and violet or purple in color.
12. The Contractor shall furnish all patch cables that are used in this Project including all Cisco catalyst 3560 SFP interconnect cables.
13. All equipment shall be installed in a rack-mounted cabinet with a locking security door.

G. Device Selection/Installation

1. Each classroom should have an I8SCMF installed in a flush mounted box on the back wall of the classroom.
2. I8SCMF should be installed in non classroom locations anywhere a clock would be required.
3. I8SCMF speakers will be installed in locations requiring a speaker but no clock.
4. IHVP speakers will be installed in all exterior locations and any area deemed as a high vandalism area.
5. All clock and speakers shall be installed per the manufacturer's recommendation.
6. All wall penetrations and clock & speaker locations that are in plain sight and not covered by a replacement clock speaker combo or outdoor speaker shall be patched and painted to match existing wall.
7. All outdoor speakers must be adequately sealed to prevent water penetration for the duration of the warranty period. Any equipment damaged by moisture is to be

replaced, not repaired, by the Contractor responsible for the warranty period.

8. Contractor to ensure that bell schedules are programmed, and that a manual bell and public announcement can be accomplished through the existing VoIP telephone system.
9. Bell sounds shall be clear of any distortion, and at an acceptable level based on ambient noises.
10. Contractor to provide two (2) spare interior speaker/clock combos and two (2) exterior speakers at the completion of the project to the maintenance and operations audio visual department

2.17 CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM

- A. Acceptable CCTV Manufacturers. All equipment listed herein will be by:
 1. CCTV Cable: Genesis 4-pr UTP cable.
 2. Cabinets, Racks, Wire Management, and Ladder tray: Chatsworth, Southwest Data Products or UL Listed and approved equal.
 3. Riser and Outside Plant (OSP) Fiber Cable: Belden, AMP, or Superior Essex.
 4. CCTV components: Bosch cameras, Bosch VMS, Bosch storageserver.
 5. UPS: Tripp-Lite Smart UPS
 6. Ethernet switches: Cisco Catalyst, see system sections for more information.
- B. It is the responsibility of the bidder to insure that the proposed product meets or exceeds every standard set forth in these specifications and the equipment's technical data sheets.
- C. The functions and features specified are vital to the operation of this facility. Therefore, inclusion of a component's manufacturer in the list of acceptable manufacturers does not release the Contractor from strict compliance with the requirements of this specification.
- D. See Quality Assurance section of this specification for additional product substitution requirements.

2.18 CCTV SYSTEM EQUIPMENT

A. Outdoor Cameras

Bosch Dinion	LTC0498/21
Bosch Dinion IP	NBN49828 IP
Bosch Dome	VDN0495V0321
Bosch IP Dome	NDN498V0321P

B. Indoor Cameras

Bosch Indoor Dome	LTC/146321
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C. Lens

Bosch Varifocal Lens	5/50 MM LTC 374/20
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D. Bosch Housings and Mounts

Bosch Housing	UHI0G0
Bosch Mount	LTC921500

E. Bosch Encoders

Single channel encoder	VIPX1
Dual channel encoder	VIPX2

F. Baluns

Nitek	VN43ATF
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G. Cabinets

Mid Atlantic	NO-ERK 2125
Mid Atlantic	Doors NO FD21

H. Digital Recorder

Bosch Recording Station with 15 inch monitor	BRSRAC28100A BRS2U
Recording station expansion license	BOS-BRSXCAM04A

I. Camera Power Supplies

Amesco Plug in Power Supply	40VA120VAC
Altronics	ALT TV248 (8 Output Power Supply)

J. Camera Wiring

Cat 6 Green Jacket Cable (Genesis)
Power over Ethernet
WS-3560X-24PS
WS-C3750G-12S-S Catalyst 3750 SFP Standard Multilayer image

K. Device Selection/Installation

1. The DVR shall be included with each installation unless the existing DVR has the expansion capacity to include the new camera installation.
2. All outdoor cameras must be adequately sealed to prevent water penetration for the duration of the warranty period. Any equipment damaged by moisture is to be replaced, not repaired, by the Contractor responsible for the warranty period.
3. Camera height where possible shall be twenty (20) feet above grade, and five (5) feet down from any accessible roof. Obtain direction from the District in cases where this is not possible.

2.19 TERMINAL BACKBOARDS

- A. Where indicated on drawings, provide new plywood terminal backboards. Use Douglas Fir Plywood, A/C grade, finished one side and prime coat painted on all surfaces with a finish coat of fire retardant intumescent white enamel. On each plywood sheet leave one (1) Fire Marshal Stamp unpainted for inspection. Unless otherwise indicated, use 8'-0" high x length as shown on drawings x 3/4" thick plywood. See backboard elevations for more information.

2.20 UNSPECIFIED EQUIPMENT AND MATERIAL

- A. Any item of equipment or material not specifically addressed on the drawings or in this document and required to provide a complete and functional SCS installation shall be provided in a level of quality consistent with other specified items.

2.21 FIRE RATED PATHWAY

- A. The firewall through-penetration shall be a manufactured, UL Classified, firestop device / system designed to allow cables to penetrate fire-rated walls with a built-in fire sealing system that automatically adjusts to the amount of cables installed.
- B. The firestopping device shall be capable of installation in new construction or retrofit in existing structures.
- C. The device shall be UL Tested and Classified in accordance with ASTM E814 (UL 1479) and with ratings up to and including 2 hours.
- D. Manufacturer: Specified Technologies Inc., EZ-Path (#EZDP33FW) or equal by Wiremold.

2.22 UNINTERRUPTABLE POWER SUPPLY

- A. Provide the following Tripp Lite UPS products or equivalent at each MDF and IDF location. Contractor shall install and test each UPS component per the manufacturer's directions.

ALL IDFs:

1	SU1000RTXL2UA	1000VA, On-Line, rack mount UPS
1	SNMPWEBCARD	Management card- connects UPS to network
2	BP24V70-3U	External battery pack

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. The wiring of the system shall be executed in accordance with the drawings and the equipment manufacturer's wiring diagrams. Should any variations in these requirements occur, the Contractor shall notify the Owner's Project Manager before making any changes. It shall be the responsibility of the manufacturer-authorized distributor of the approved equipment to install the equipment and guarantee the system to operate as per plans and specifications.

- B. Furnish all conductors, equipment plugs, terminal strips, etc., and labor to install a complete and operable system.
- C. The cables within the rack or cabinets shall be numbered for identification using machine generated labels.
- D. Splices of cables are not acceptable.
- E. The labor employed by the Contractor shall be regularly employed in the installation and repair of communication systems and shall be acceptable to the Owner's Project Manager to engage in the installation and service of this system.
- F. The Contractor shall thoroughly clean all equipment and materials. All exposed parts of the equipment, cabinets, and other equipment shall be left in a clean condition, unblemished and free of all dirt, dust, smudges, spots, fingerprints, etc. The Contractor shall remove all debris and rubbish created in the course of this project. The Contractor shall thoroughly clean all buildings of any dirt, debris, rubbish, marks, etc., caused by the performance of this work.
- G. The system must meet all local and other prevailing codes.
- H. All cabling installations shall be performed by qualified technicians.
- I. In order to ensure the least amount of cable untwisting, it is required that all cables shall be stripped using a special tool.
- J. Cable lubricants (i.e. Polywater) shall be used to reduce the cable pull tension stated by the cable manufacturer during cable installation in conduits and innerduct. Contractor shall verify the acceptability of the lubricant to be used with the cable manufacturer, prior to using such a lubricant. Lubricants that harden after installation are not allowed. Submit all proposed lubricants for approval PRIOR to use on low voltage, A/V, coax, fiber, and data cables. Cable lubricants shall be allowed to dry a minimum of 15 days before performing certification tests.
- K. Under no circumstance are "channel locks" or other pliers to be used to install or terminate cables.
- L. Cables may be run exposed above ceilings, provided the cabling is supported independent of other utilities such as conduits, pipes, and the ceiling support systems. The Contractor shall include all costs in base bid for any additional supports/seismic bracing required by the Local Authority having Jurisdiction. The cables shall not be laid directly on the ceiling panels. The use of hook and loop ties shall be done in accordance with the cable manufacturer's requirements. The cable jacket composition must meet local and all other prevailing fire and safety codes.
- M. All firewalls penetrated by structured cabling shall be sealed by use of a non-permanent fire blanket or other method in compliance with the current edition of NFPA and the NEC or other prevailing code and must be a system listed by UL. The Contractor must not use concrete or other non-removable substance for fire stopping on cable trays, wireways or conduits. Contractors who use this method will be required to replace all cables affected and provide the original specified access to each effected area. This requirement also applies to maintaining fire ratings of all floors penetrated by conduits or devices designated for use by voice and data cabling.

- N. All equipment racks shall be bolted to the structural floor by the SCS Contractor in the location shown on drawings. Wall mounted relay rack and wall mounted cabinet kits shall be screwed to studs, not drywall.
- O. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Contractor before final acceptance at no cost to the Owner.
- P. The cable manufacturer's minimum bend radius and maximum pulling tension shall not be exceeded.
- Q. Cable raceways, when required, shall not be filled greater than the NEC maximum fill for the particular raceway type.
- R. Roof penetrations are prohibited. No conduit shall be installed on roofs or route horizontally on exterior walls.

3.2 SPECIFIC SYSTEM INSTALLATION REQUIREMENTS

- A. All communications cabling used throughout this project shall comply with the requirements as outlined in the NEC Articles 725, 760, 770, and 800 and the appropriate local codes. All copper cabling shall bear UL listed type CMP (Plenum Rated) and/or CM/G (General Purpose) and/or CMR (Riser Rated). All fiber optic cabling shall bear OFNP (Plenum Rated) and/or OFNR (Riser Rated) and/or OFN/G (General Purpose). SCS Contractor is responsible for installing appropriately rated cable for the environment in which it is installed.
- B. Cable Pathways:
 - 1. In suspended ceiling, accessible ceiling, and raised floor areas where duct, cable trays or conduit are not available, the Contractor shall bundle, in bundles of 48 or less, station or other cabling with half inch hook and loop strips, but not deforming the cable geometry. Cable bundles shall be supported via "J" hooks attached to the existing building structure and framework at a maximum of five (5) foot intervals. Plenum rated hook and loop ties will be used in all appropriate areas. In areas where two or more bundles are traveling in close proximity, utilize a Chatsworth Rapidtrak Cable support system. The Contractor shall adhere to the manufacturers' requirements for bending radius and pulling tension of all cables.
 - 2. Cables or J-hooks shall not be attached to lift out ceiling grid supports or laid directly on the ceiling grid.
 - 3. Cables or J-hooks shall not be attached to or supported by fire sprinkler heads, HVAC ducts, or delivery systems or any environmental sensor located in the ceiling air space.
 - 4. Where additional conduit(s)/sleeve(s) are required, but not provided by the electrical Contractor, the SCS cabling Contractor shall be responsible to provide such conduit(s)/sleeve(s). Conduit(s) and sleeve(s) shall be of suitable material, sized, installed, fire-stopped, and grounded as required by the NEC, ANSI/TIA/EIA standards and all other applicable codes and standards. Any conduit(s) and sleeve(s) added by the SCS Contractor shall be approved by the Owner's Project Manager prior to rough-in.

5. All J-hooks shall be rated and designed for CAT6 cabling.
- C. Sealing of openings between floors, into or through rated fire and smoke walls, existing or created by the Contractor for placement of new or removal of old cable into or through shall be the responsibility of the Contractor. Sealing material (Approved UL listed system) and application of this material shall be accomplished in such a manner that is acceptable to the local fire and building authorities having jurisdiction over this work. Creation of such openings as are necessary for cable passage between locations as shown on the drawings shall be the responsibility of the Contractor's work. Any openings created by or for the Contractor and left unused shall also be sealed as part of this work.
1. Firestopping work shall be performed by a single Contractor to maintain consistency and accountability on the project.
 2. The Contractor shall install penetration firestop seal materials in accordance with design requirements, and manufacturer's instructions.
 3. The Contractor's installer shall be certified, licensed or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements.
 4. All installed through penetration firestops shall be identified via label, or stencil. Label shall state that the fill material around the penetrating item is a firestop, and that it shall not be disturbed unless by an authorized Contractor. The label shall include the firestop brand name, and the classified system number for which it was installed.
 - a. Sample Label:

MANUFACTURER'S

NAME:
ATTENTION
Fire Rated Assembly
For Any Changes To This System, Please Refer To UL System Listed Below
PRODUCT:
HOUR
RATING: UL
SYSTEM:
INSTALLATION DATE:
INSTALLED BY:
LICENSE NUMBER:
PHONE:
FAX:
- D. The Contractor shall be responsible for damage to any surfaces or work disrupted as a result of his work. Repair of surfaces, including painting, shall be included as necessary.
- E. Cable bundles within the MDF/IDF shall be dressed into bundles of no more than twenty- four (24) cables. Maintain each bundle with half inch-wide hook and loop strips spaced every 12 inches maximum.
- F. The Contractor shall install all patch cords per direction of the Owner's project manager

in a neat and systematic fashion. Prior to installing all patch cords, the Contractor shall install patch cords in a single rack to demonstrate work practices to the Owner's project manager. Only after any corrections/modification to the installation as directed by the Owner's project manager, may the Contractor continue installing the patch cords in the remaining racks.

- G. Each equipment cabinet and rack requires its own dedicated grounding connection to the grounding infrastructure. Grounding infrastructure shall consist of a dedicated #6 AWG (min.) green conductor from every rack/cabinet back to the TMGB/TGB. All ground conductor attachments to the TMGB/TGB shall utilize 2-hole compression lugs. See Section 2.13 Grounding System and Conductors of this document for more information.

In raised-floor environments, the ground conductor shall attach to the lowest holes on the front rail of each rack/cabinet.

- H. Rack/cabinet mounted equipment shall be grounded via the chassis, in accordance with manufacturer's instructions. The equipment chassis shall be bonded to the rack/cabinet using one of the following methods:
1. If the equipment has a separate grounding hole or stud, use a #10-AWG ground wire from the chassis ground hole/stud to the rack grounding bus.
 2. If the manufacturer suggests grounding via the chassis mounting flanges, use tri-lobular thread-forming screws (not self-tapping or sheet metal screws) to attach the equipment to the rack/cabinet rails. If the equipment mounting flanges are painted, remove the paint and apply an anti-oxidant, or use tri-lobular thread-forming screws and two (2) "Type B" internal-external tooth lock washers to safely ground equipment to the rack.
- I. Bonding of ladder tray sections- Attach bonding straps to each ladder tray section by utilizing either two (2) tri-lobular thread-forming screws (not self-tapping or sheet metal screws) or by using two (2) standard bolts with two (2) "Type B" internal-external tooth lock washers per bolt. If thread-forming screws are not used, remove paint at each connection point and use an approved anti-oxidant prior to attaching the bonding strap.
- J. All installation shall be done in conformance with TIA/EIA 568-C standards, BICSI TDM guidelines and manufacturer's installation guidelines. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines will require the Contractor to provide, in a timely fashion, any additional material and labor necessary to properly rectify the situation to the satisfaction and written approval of the Owner's Project Manager. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.
1. Bonding and Grounding: The Contractor shall be responsible for providing an approved ground at all distribution frames. The Contractor shall also be responsible for ensuring ground continuity by properly bonding all appropriate cabling, closures, cabinets, service boxes, and framework. All grounds shall consist of #6-AWG copper wire and shall be supplied from an approved building ground and bonded to the main electrical ground. All cable sheaths and splice cases shall be grounded to a Telecommunications Ground Bus. All grounding must be in accordance with the NEC, NFPA, ANSI-J-STD-607-A and all local codes and practices. The Electrical Contractor shall be responsible for providing a

properly sized grounding conductor from the main electrical ground to the telecommunications ground bus in each MDF/IDF room. The SCS Contractor shall be responsible to provide the telecommunications busbar, attach the Electrical Contractor-provided ground conductor, and bond all required equipment and components within each MDF/IDF to the busbar.

2. **Power Separation:** The Contractor shall not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.
3. **Miscellaneous Equipment:** The Contractor shall provide any necessary screws, anchors, clamps, hook & loop ties, distribution rings, wire molding (MDF & IDF locations), miscellaneous grounding and support hardware, etc., necessary to facilitate the installation of the System.
4. **Special Equipment and Tools:** It shall be the responsibility of the Contractor to furnish any special installation equipment or tools necessary to properly complete the System. This may include, but is not limited to, tools for terminating cables, testing and splicing equipment for copper/fiber cables, communication devices, jack stands for cable reels, or cable winches.
5. **Labeling:** The Contractor shall be responsible for printed labels for all pull boxes, conduits, cables, protectors, racks, cabinets, patch panels, connector panels, cords, distribution frames, and out let locations, according to the specifications. No labels are to be written by hand. Contractor shall submit sample of all labeling schemes for Owner's consideration and approval. Final label scheme shall be by direction and approval of the Owner.
6. **Cable Storage:** The Contractor shall not roll or store cable reels without an appropriate underlay and the prior written approval of Owner's Project Manager.
7. **Cable Records:** The Contractor shall maintain conductor polarity (tip and ring) identification at the main equipment room (switch room), risers, and station connecting blocks in accordance with industry practices, but only in locations authorized by the Owner's Project Manager. Contractor to provide spread sheet for all outdoor backbone and indoor riser backbone cables tested.

3.3 STRUCTURED CABLING AND INTERCOM-PUBLIC ADDRESS-CLOCK GENERAL INSTALLATION DESCRIPTION

- A. The structured cabling system shall consist of any or all of the following subsystems:
 1. Work Area Subsystem
 2. Horizontal Subsystem
 3. Administration Subsystem
 4. Backbone Subsystem
 5. Equipment Subsystem
- B. **Work Area Subsystem:** The Work Area Subsystem provides the connection between the information outlet and the station equipment in the work area. It consists of cords,

adapters, and other transmission electronics.

1. Contractor shall supply the wiring or cords that connect terminal devices to information outlets. This includes mounting cords and connectors, as well as extension cords.

C. Horizontal Subsystem: The Horizontal Subsystem provides connections from the horizontal cross connect to the information outlets (IOs) in the work areas. It consists of the horizontal transmission media, the associated connecting hardware terminating this media and IOs in the work area. Each floor of a building is served by its own Horizontal Subsystem.

1. Horizontal Cabling

- a. Contractor shall supply horizontal cables to connect each information outlet to the backbone subsystem as shown on the drawings.
- b. Unless otherwise noted on the floor plans or within this document, the type of horizontal cables used for each work location shall be 4-pair unshielded twisted pair (UTP).
- c. The 4-pair UTP cables shall be run using a star topology format from the administration subsystem to every individual information outlet. All cable routes, other than those dictated on the drawings, are to be approved by Owner's Project Manager prior to installation.
- d. The length of each individual run of horizontal cable from the administration subsystem to the information outlet shall not exceed 295-ft (90 m).
- e. Contractor shall observe the bending radius and pulling strength requirements of the 4-pair UTP cable during handling and installation.
- f. Each run of cable between the termination block and the information outlet shall be continuous without any joints or splices.
- g. All station cable shall be placed in the interior of walls unless otherwise noted or obstructed.
- h. In the event Contractor is required to remove ceiling tiles, such Work shall not break or disturb grid. Removal of the ceiling grid must be coordinated with the Owner's Project Manager. All insulation shall be replaced in its original location.
- i. Avoid electromagnetic interference (EMI) by maintaining adequate physical separation between telecommunications cabling and possible sources such as, but not limited to, electric motors, electric erasers, electric pencil sharpeners, transformers, fluorescent lighting that share distribution space with telecommunications cabling, copiers that share work area space with line cords and terminals, large fax machines and power cords that support such equipment.
- j. Contractor shall provide Owner's Project Manager with detailed cable run diagrams for cable runs within raised floors (if shown on plans) detailing exact locations of cable for review and written approval by Owner's Project Manager.

- k. Conduit runs installed by the Contractor should not exceed 100 feet or contain more than two 90 degree bends without utilizing appropriately sized pull box. Pull boxes are not to be used in lieu of a bend.
 - l. Station cables and tie cables installed within ceiling spaces shall be routed through these spaces at right angles to electrical power circuits.
 - m. Each station cable shall have 1 meter of service slack configured in an "S" shape via J-hooks at rack or wall field end and 1 foot of service loop at station outlet end. Service slack shall be located within 15' of the MDF/IDF as required to maintain a neat and "workmanship like" installation.
- D. Administration Subsystem: The Administration Subsystem links all of the subsystems together. It consists of labeling hardware for providing circuit identification and patch cords or jumper wire used for creating circuit connections at the cross connects. All wall field layouts must be approved by Owner's Project Manager prior to rough-in and installation.
 - 1. Separate termination fields shall be created for voice, data and building service applications.
 - 2. Termination blocks that require rotation after connection of horizontal/vertical wiring will not be allowed.
 - 3. Contractor shall supply cross-connect wire, patch cords and fiber patch cords for cross-connection and inter-connection of termination blocks and lightguide interconnection units.
- E. Backbone Subsystem:
 - 1. The main cable route within a building is called the Backbone Subsystem. It links the main distribution frame (MDF) in the equipment room to each intermediate distribution frame (IDF). It consists of the backbone transmission media between these locations and the associated connecting hardware terminating this media. It is normally installed in a star topology, with first-level backbone cables beginning at the main cross connect. If needed, second-level backbone cables begin at intermediate cross connects.
 - 2. The backbone subsystem shall include vertical runs (riser) of in-building cable between floors of a multi-story building, if applicable.
 - 3. All fibers will be run in innerduct and terminated in the MDF/IDF Rooms, or as otherwise indicated on drawings, with connectors, type as specified elsewhere, in rack mounted or wall mounted fiber patch panels equipped with sufficient panels, couplers and jumper storage shelves to terminate and secure all fibers. All innerduct (Carlisle or equal) shall be corrugated and a minimum of 3/4" in diameter unless otherwise indicated on plans. Inner duct shall be plenum, riser or general rated as required by the environment in which it is to be installed.
 - 4. Contractor shall supply unshielded 23-AWG multi-pair copper cables and optical cables as the riser cables. The cable shall support voice and data applications. Contractor shall observe the bending radius and pulling strength requirements of all backbone cables during handling and installation.

- F. Equipment Room Subsystem: The Equipment Subsystem consists of shared (common) electronic communications equipment in the equipment room or telecommunications closet and the transmission media required to terminate this equipment on distribution hardware.

3.4 CCTV GENERAL INSTALLATION REQUIREMENTS

- A. Workmanship on the installed system shall be of professional quality, best commercial practice, and accomplished by persons experienced in the techniques and standards of the Digital Video surveillance system industry.
- B. Cable/Wiring:
 - 1. All cabling, wiring, and associated cabling components, shall be yellow for the Digital Video Surveillance System.
 - a. SCS cable for the Digital Video Surveillance System: Category-6 (yellow)
 - 2. All cabling/wiring, shall be as shown, installed and connected as per manufacturer's instructions.
 - 3. All Cabling/Wiring shall be run in continuous lengths between the MDF/IDF's to the cameras and equipment, no splicing permitted.
 - 4. All SCS cabling shall retain a 25-foot service loop, coiled per cabling manufacture's recommendations, after termination and properly supported per standards and norms. At the camera, the cable shall be terminated in a 8P 8C (RJ45) Jack and housed in a 1 port surface mount box (white) within the building. The camera shall be connected/patched to the 8P8C (RJ45) jack with a patch cord supplied by the Contractor, and it is the responsibility of the Contractor to verify the lengths prior to ordering (category and manufacture of patch cord to match cabling infrastructure.) Special care shall be taken to insure proper slack or loops being left in junction boxes.
 - 5. Surveillance system Contractor shall check drawings for adequacy of wiring system and include in bid amount all additional wiring necessary for system proposed and actually installed.
- C. Prior to installing the Bosch Video Management Software BVMS on any District owned Personal Computer or workstation, District shall be notified for release of required IP Addresses and permission to proceed.
- D. Install devices in accordance with manufacturer's and engineer's instruction at locations indicated on the drawings.
 - 1. Ensure selected location is secure and offers protection from accidental damage.
 - 2. Location must provide reasonable temperature and humidity conditions, free from sources of electrical and electromagnetic interference.
 - 3. Install cameras with 96-inch minimum clear space below cameras and their mounting. Change type of mounting to achieve required clearance.

E. Surveillance System coverage areas:

1. Refer to drawings for camera locations. Final selection for placement will be accomplished with a District Technology Representative.
2. Digital masking of private, residential/business areas from the camera's screen shot is required.

F. Communications of cameras summary:

1. Refer to General Electrical Section 16010.
2. Connectivity/Cabling solution is to be consistent throughout the site, throughout all systems, and match existing solution of each site.
3. Connectivity/Cabling solution for IP cameras shall be 4-pair UTP Category-6 cabling Yellow and OM3 fiber optic cabling.
4. Connectivity/Cabling solution for analog cameras, shall be RG 6 quad shield coax cabling.
5. Connectivity/Cabling solution for encoders and all other associated equipment shall be 4-pair UTP Category-6 cabling Yellow and OM3 fiber optic cable.
6. Route cabling from camera location to nearest IDF.
7. Connectors are to be 8P8C (RJ45) female connector.
 - a. Terminate at the camera with an 8P8C (RJ45) jack installed in a 1 port surface mount box (white.)
 - b. Terminate at the MDF/IDF on existing or new patch panels.
 - 1) Where new patch panels are to be installed, install 1:1 wire manager to patch panel.
 - 2) All new patch panels are to be 48 -port unless otherwise noted. Wire managers are to be 2 RMU size, and match existing manufacturer's model.

3.5 DAMAGES

- A. The Contractor will be held responsible for any and all damages to portions of the building caused by it, its employees or sub Contractors; including but not limited to:
1. Damage to any portion of the building caused by the movement of tools, materials or equipment.
 2. Damage to any component of the construction of spaces.
 3. Damage to the electrical distribution system.
 4. Damage to the electrical, mechanical and/or life safety or other systems caused by inappropriate operation or connections made by the Contractor or other actions of

Contractor.

5. Damage to the materials, tools and / or equipment of the Owner, its consultants, agents and tenants.

3.6 PENETRATIONS OF WALLS FLOORS AND CEILINGS

- A. Unless specifically shown on the drawings, the Contractor shall make no penetration of floors, walls or ceiling without the prior written approval of the Owner's Project Manager.
- B. Any penetrations through acoustical walls or other walls for cable pathways / cables shall be sealed by the Contractor in compliance with applicable code requirements and as directed by Owner's Project Manager.
- C. Any penetrations through fire-rated walls for cable pathways / cables shall be sealed by the Contractor as required by code and as directed by Owner's Project Manager. The Contractor shall be required to work together with the General Contractor and the Electrical Contractor to coordinate and develop all fire stopping methods prior to any cable installation. The Contractor shall also, prior to the commencement of on-site activities, submit to Owner's Project Manager, details of any special systems to be used.
- S. Roof penetrations are prohibited. No conduit shall be installed on roofs or route horizontally on exterior walls.

3.7 TESTING/WARRANTY

- A. Structured Cabling System and Intercom/PA/Clock IP System
 1. The Contractor shall provide competent, test equipment manufacturer-trained engineers and/or technicians, authorized by the manufacturer of the cabling system, to technically supervise and participate during all tests for the systems.
 2. The Contractor shall test and certify the cabling system to minimum standards as set forth in the TIA/EIA-568-C specifications for 100BaseTX Ethernet and for Category-6 cable, token ring, and 1000baseT signals.
 3. All cables and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions. All conductors of each installed cable shall be verified usable by the Contractor before system acceptance. Any defect in the cable system installation including but not limited to cable, connectors, feed-through couplers, patch panels, splices, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
 4. Each cable shall be tested for continuity on all pairs and/or conductors. Twisted-pair voice cables shall be tested for length, continuity, pair reversals, opens, shorts, transpositions, presence of AC and DC voltages and opens using a "green light" type test set. Twisted-pair horizontal cables shall be tested for the all of the above requirements, plus tests that indicate installed cable performance. These cables shall be tested using a TIA/EIA-568-C.2-1 Category-6 Level III / IEC 61935 Level III or better ETL certified cable tester/analyzer.

5. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests.
6. The test shall be recorded as pass/fail as indicated by the test set in accordance with the manufacturers recommended procedures, 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 before final acceptance.
7. Each installed cable shall be tested for installed length using a Time Domain Reflectometer (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 TIA/EIA - 568-C Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number.
8. Multi-pair cables, record the following tests on every cable pair in each multipair cable using a TDR type device: record the shortest pair length, continuity, pair reversals, shorts, opens, transpositions, presence of AC and DC voltage.
9. Enhanced Category-6 data cable shall be performance verified using an automated test set. This test set shall be capable of testing for the continuity and length parameters defined above, and provide results for the following tests:
 - a. Attenuation (Insertion Loss).
 - b. Return Loss (RL).
 - c. Near End Crosstalk (NEXT) – measured at both ends of each cable pair.
 - d. Attenuation to Crosstalk Ratio (ACR).
 - e. Power Sum Near End Crosstalk (PSNEXT).
 - f. Power Sum Attenuation to Crosstalk Ratio (PSACR).
 - g. Far End Crosstalk (FEXT).
 - h. Equal Level Far End Crosstalk (ELFEXT).
 - i. Power Sum Equal Level Far End Crosstalk (PSELFEXT).
10. Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the ANSI/TIA/EIA Standard, and the result shown as pass/fail. Test results shall be printed directly from the test unit or from a download file using an application from the test equipment manufacturer. The printed test results shall include all tests performed, the expected test result, and the actual test result achieved.
11. Optical Fiber Cable Testing: All fiber testing shall be performed on all fibers in the completed end to end system by test equipment manufacturer-trained engineers and/or technicians. There shall be no splices unless clearly defined in Section 3 of this specification or on the plan drawings. Testing shall consist of a bi-directional end to end OTDR trace performed per ANSI/TIA/EIA 455-61 & ANSI/TIA/EIA 526 and a bi-directional end to end power meter test performed per ANSI/TIA/EIA 455-

53A. The system loss measurements shall be provided at 850 and 1300 nanometers for multimode fibers and 1310 and 1550 for single mode fibers.

- a. Pre-installation cable testing: The Contractor shall test all lightguide cable prior to the installation of the cable. The Contractor shall assume all liability for the replacement of the cable should it be found defective during the warranty period.
 - b. Loss Budget: Fiber links shall have a maximum loss of: (allowable cable loss per km) (km of fiber in link) + (.4dB) (number of connectors) = maximum allowable loss.
 - c. Any link not meeting the requirements of the standard shall be brought into compliance by the Contractor, at no additional charge to Owner.
12. The Contractor shall provide test documentation to the Owner's Project manager in a three ring binder(s) and in CD format within three weeks after the completion of a specific project. The binder(s) shall be clearly marked on the outside front cover and spine with the words "Test Results", the project name, and the date of completion (month and year). The binder shall be divided by test type. A paper copy of the test results shall be provided that lists all the links that have been tested, and include link name, overall pass/fail evaluation, date and time of test, cable type and NVP value. Detailed test results shall be provided for each link tested and shall include length, propagation delay, delay skew, insertion loss, return loss, NEXT, ELNEXT, ACR, PSNEXT, PSELFEXT, and P SACL. Detailed test results for each link will also include customer site name, name of standard selected to execute the tests, date and time test results were saved in memory of test unit, brand name model and serial number of tester and revision of the tester software and test standards database in the tester. Individual test data within each section shall be presented in the sequence listed in the test summary records. Unless a more frequent calibration cycle is specified by the manufacturer, an annual calibration cycle is anticipated on all test equipment used for this installation.
13. 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 collocated in the binder.
14. The entire Intercom/PA/Clock system shall be warranted free of mechanical or electrical defects for a period of five years after final acceptance of the installation.
15. Any Intercom/PA/Clock Any equipment that is not installed per the manufacturer's recommendation shall be replaced promptly and at no cost to the District.
16. Any material showing mechanical or electrical defects shall be replaced promptly at no expense to the District.
17. Contractor shall test all intercom/public address speaker volume levels in the presence of the District's representative. Contractor shall adjust all individual speaker sound levels to the satisfaction of the District's representative.
18. The Intercom/public address system shall provide clear, natural sound uniformly distributed throughout the designated areas.

19. Provide all labor and material warranties for each system, as described elsewhere in this document.
20. At the District's direction, the Contractor shall perform additional random testing which shall consist of a random sample of up to 10% of each installation distribution system. The Contractor shall assume responsibility for providing the proper test equipment and staff to conduct tests. The District representative shall witness the tests.
21. Should the initial 10% test not be 100% successful (all drops testing over CAT6 up to 250MHz), the Contractor shall assume responsibility to repair/replace non-passing links, at the direction of the District, and the links to re-verify and resubmitted. A 20% random sample shall then be conducted to ensure proper performance of the system.
22. Should there be failure in this re-test, the Contractor shall be responsible to repeat the re-test procedure until such time as all cabling is verified.

B. Closed Circuit Television CCTV System

1. Provide all instruments for testing and demonstrating in the presence of the Owner's inspector that the frequency response is as stated in the factory data sheets. Category-6 UTP cables shall be tested and certified using a Level III cable analyzer (Fluke 4300 or equal). The CCTV Contractor must submit cable test results for review prior to project completion and acceptance.
2. Adjust all cameras and software to provide a video surveillance system operating at maximum capability.
3. CCTV System Testing and Verification Requirements
 - a. System shall be complete and properly operating prior to calling for the test. The Owner, Inspector, Contractor and Engineer shall walk-test the system at Owner's option and Contractor shall make minor satisfactory adjustments to the system in the presence of the Inspector. This test shall be performed during a time when there are no other persons on the site.
4. Final Installation Checklist. Contractor shall verify the following:
 - a. Network connectivity to all cameras.
 - b. All exterior camera mounts and connections for weather-tight seals.
 - c. All exposed conduits are properly secured, and painted to match surrounding surfaces.
 - d. All penetrations properly patched and painted to match surrounding surfaces.
 - e. Proper labeled at camera, patch panel, PoE injector, wall mounted power supply, server and monitor. MAC address label on each camera is machine generated and visible.
 - f. Perform walk-test to verify objects are detected and classified as expected.

- g. View software installed and tested on all personal computers.
 - h. Camera imager settings set correctly (indoor vs. outdoor mode, AGC, shutter speed, etc.).
 - i. Storage and compression settings for each camera.
 - j. Analytics settings on each camera (indoor vs. outdoor mode, privacy mask, etc.).
 - k. Rules configured for each camera.
 - l. Supervisor password changed from default and provided to District's representative.
 - m. Operator group permissions set and verified.
 - n. Additional user accounts, clients, created.
 - o. Remote access created.
 - p. Storage server functionality.
 - q. Operating system software updated with latest patches.
 - r. Camera time and time zone settings and/or NTP server settings verified.
5. Tests:
- a. Test all cameras, software and systems, and place in proper and specified working order prior to demonstration of the system.
 - b. Perform all tests as required by Owner and by authorities having jurisdiction over the site.
 - c. Testing shall be in the presence of the Owner, Architect, Construction Manager, Engineer, and representatives of the authorities having jurisdiction.
6. Verification of Performance:
- a. Prior to acceptance of the work, the surveillance system integrator/installer shall demonstrate to the Owner, Architect, Construction Manager, Engineer, and representatives of the authorities having jurisdiction, all features and functions of the system, and shall instruct the Owner in the proper operation and event sequences of the system.
 - b. Arrange with the Owner's designated representative the date and times for performing the system tests. The Owner will select date and time for demonstration and test.
 - c. Demonstrate picture quality and resolution on each camera. Ensure Owner's acceptance.
 - d. Demonstrate acceptable picture view and angle on each camera. Ensure each camera view is acceptable to Owner.

- e. Demonstrate acceptable picture quality on network workstation monitor and on each video monitor (if required on project).
 - f. Demonstrate switching, recording and playback functions for each camera and network server software.
 - g. Demonstrate how to add and delete cameras, and how to edit camera settings in the system software.
 - h. Demonstrate camera functionality on pan/tilt/zoom cameras (PTZ) throughout the entire range of possible camera positions. Ensure primary views are acceptable. Demonstrate the view obtained by each preprogrammed camera position.
 - i. Demonstrate proper video image retrieval from storage server. Demonstrate proper method of creating long term storage of a video event on various portable media (DVD, thumb drive, and external hard drive).
 - j. Demonstrate acceptable night time automatic activation of day/night cut filters and camera functionality in low light conditions.
 - k. Demonstrate acceptable system's automatic reboot/reactivate functions following unexpected loss of local power.
- 7. All cameras shall be adjusted for angle, pitch, and zoom to the Owner's satisfaction prior to acceptance. As part of training, Contractor shall demonstrate how to adjust cameras and lenses, and perform routine maintenance.
 - 8. Furnish the necessary trained personnel to perform the testing and provide instructions. Allow one (1) week of time for performing the prescribed testing.
 - 9. Test equipment: Provide two (2) portable radio transceivers to be used when walk-testing the surveillance system. The transceivers shall be capable of communication throughout the entire site.

3.8 COMPLETION OF WORK

- A. At the completion of the Systems, the Contractor shall restore to its former condition, all aspects of the project site and on a daily basis, shall remove all waste and excess materials, rubbish debris, tools and equipment resulting from or used in the services provided under this Contract. All clean up, restoration, and removal noted above will be by the Contractor and at no cost to Owner. If the Contractor fails in its duties under this paragraph, Owner may upon notice to the Contractor perform the necessary clean up and deduct the costs thereof from any amounts due or to become due to the Contractor. It shall be the Contractor's responsibility to remove trash from the areas it is working in and bring trash and debris to the Contractor provided dumpster.

3.9 ADJUSTMENTS

- A. Occupancy Adjustments: When requested within 32 months of the date of substantial completion, provide up to four (4) on-site visits for each site for assistance in adjusting system to suit actual occupied conditions and to optimize performance of the installed equipment, reference 3.9.A Attachments "System Tuning & Adjustment." Tasks shall

include, but are not limited to, the following:

1. Check cable connection
2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed
3. Adjust all preset positions; consult District Technology representative.
4. Adjust camera views as needed: consult District Technology representative.

3.10 INSPECTION

- A. On-going inspections shall be performed during construction by the District's representative. All work shall be performed in a high quality manner and the overall appearance shall be clean, neat and orderly. Any work that does not meet the District's representative's approval shall be removed and reinstalled by the Contractor at no additional cost to the District.

3.11 LABELING REQUIREMENTS

- A. Numbers must be assigned to each outlet location using the designation convention as described in this document. Plan drawings with outlet locations and configuration information have been furnished to the Contractor. Contractor shall provide the equipment as necessary to generate Panduit PAN-CODE (or Equal) laser printer generated self-laminating labels using the numbering convention shown below and as specified herein. Before any permanent labels are installed on blocks, face plates or cables, Contractor shall submit a sample label of each various type listed below to Owner's Project Manager for written approval to ensure compliance with the labeling scheme, legibility, etc. Final label scheme shall be determined by the Owner's decision. Contractor is responsible to provide and install the labeling scheme as described below.
- B. All faceplates, cables, patch panel and wall field terminations shall be machine labeled and designated as specified in the following examples:

1. Faceplate labeling format: Building-Room-Port. The format is B-RRR-

PPP. Wall outlet sample: D-102-006

D	building number
102	room number
006	port number

2. IDF/LIU labeling MUST be inside a properly sized locking cabinet, which corresponds with each building number per plan drawings.

IDF cabinet sample:

IDF 5 IDF IDF

cabinet	
5	building number

- C. Backbone and Riser Cable Labeling. All backbone and riser cables (copper, fiber, coax, etc) will be labeled to reflect the origin and destination abbreviation for the cable and pair counts on large font (16 pitch) self-laminating labels, which shall be located within 18 inches of each end of the cable. Labels shall be placed on the cable to be visible without relocating surrounding cables.

Example #1:

IDF2/IDF3/CP100/01

IDF2 Cable

Origination IDF3

Cable

Destination

CP100 Cable Type & Pair or Strand Count (ex. 100-pair Copper Cable. Other possibilities include HB for hybrid fiber cable, MM f or multimode cable, and SM for singlemode cable.)

01 Cable identification number (ex. cable #01). There may be more than one backbone or riser cable with the same origin, destination and pair count.

- D. Patch Panel Labels, Horizontal. All patch panels shall have their ports numbered continuously and sequentially. For example, if there are two 48-port patch panels in an IDF cabinet, ports in the first patch panel shall be labeled 001 through 048. Ports in the second patch panel shall be labeled 049 through 096.
- E. Fiber Patch Panel Labels. All fiber patch panels will be labeled using self-laminating laser patch panel label markers. Fiber panel labels shall include all information as specified by the Owner. Contractor is responsible to provide a labeling scheme that meets with the Owner's satisfaction. At a minimum, the fiber panel label card shall indicate: destination of connected cables on the patch panel followed by a slash (/), origination of connected cables on the patch panel followed by a slash (/), and the port number adjacent to the port

Example: MDF/IDF2/01

MDF Destination Patch Panel Location

Designation IDF2 Origination Patch Panel

Location Designation

01 Indicates port number on both origin and destination patch panels.

- F. Equipment Rack/Cabinet Labeling: All equipment racks/cabinets shall be labeled according to their room identifier and a two-digit number. The labels will be engraved plastic plates, with 1"-high white letters on black background. The labels will be attached to the cross member at the top front of each frame or rack with appropriately

sized sheet metal screws. Self-adhesive strips, glues, etc. are unacceptable.

Example: MDF-01

MDF Room Designation

01 Rack Identifier

- G. Innerduct and Fiber Cable Warning Labeling. The Contractor shall provide and install tags of stamped plastic for tube cable and innerduct. The labeling convention described above within Paragraph E shall apply. Additionally, the Contractor will also install fiber optic warning tags (Panduit #PST-FO) every 12 feet on all exposed fiber optic cable and on innerduct containing fiber optic cable installed within the building, also on innerduct and cable visible in each pull box, manhole, and vault.
- H. MDF/BDF/IDF Floor Plan Mounting Frame: At the MDF location, provide a full sized floor plan labeled with all drop numbers and their corresponding locations in each room of every building included in the contract scope of work. Each building floor plan shall display each cable number serviced from the MDF and IDFs, the drop's physical location, and the proper device symbol shown on the symbol legend. Mounting frames shall be equipped with removable Plexiglas front covers. Frame and cover shall be sized to house full size floor plan drawing. Coordinate location of frame with Owner's Project Manager prior to installation.
- I. Telecommunications Main Grounding Busbars (TMGB, TGB): All telecom grounding busbars shall be labeled using large font (16 pitch) self-laminating labels. Labels shall indicate "TMGB" or "TGB". If more than 1 bus bar is in the room, include a numerical indication (ex: TMGB-1).

3.12 MISCELLANEOUS PROJECT REQUIREMENTS

- A. Site Cleaning: Throughout the progress of the plant construction, the Contractor shall keep the working area free from debris of all types and remove from the premises all rubbish resulting from any work done by Contractor. On a daily basis and at the completion of its work, the Contractor shall, to the extent possible, leave the premises in a clean and finished condition.
- B. Conduits: All backbone cabling will run through dedicated conduits. All new conduits will be supplied with a pull string. Contractor shall supply pull string and pull rope for the installation of all cables in existing conduits. For all conduits left with available capacity, Contractor shall replace pull strings with 1/4-inch pull rope during the course of his work. Contractor must seal all conduits with an approved sealing compound.
- C. Cabling and Termination Identifications: All new cabling shall be of the type specified herein. Any conflicts between cabling types specified and code or design requirements shall be submitted to Owner's Project Manager for review and final disposition. All cabling shall be neatly laced, dressed and adequately supported. Cabling must be concealed to the fullest extent possible. In addition, a numbering and marking scheme must be used to identify all cable and cabling terminations. All cables, regardless of length, shall be marked and/or numbered at both ends. Marking codes and methodologies shall correspond to the instructions in this specification.
- D. Seismic Requirements: Contractor will install all equipment racks, equipment cabinet enclosures, cable runways, etc. according to DSA and local, state and/or federal code. Contractor will notify Owner's Project Manager of such requirements and shall provide such bracing as required. Contractor to coordinate all installation with the structural

Engineer of Record.

- E. Safety Requirements: Contractor will utilize appropriate personnel and display warning signs, signals, flags and/or barricades at the work site to ensure adherence to safety regulations and as prudence requires.
- F. Specification/Drawing Status: All specifications and drawings related to this project will be "frozen" after shop drawing approval. The Owner reserves the right to negotiate any future changes with the Contractor at any time.

3.13 MISCELLANEOUS SUPPORT REQUIREMENTS

- A. Upon approval of shop drawings, Contractor shall immediately place orders for all required materials, components, and supplies. In addition, Contractor shall secure and forward written confirmations (including orders and shipping dates) direct from each manufacturer/vendor to the Owner's Project Manager.
- B. Contractor shall expedite shipment of all materials, components and supplies, as necessary to ensure the successful completion of the Project by the date required. All costs for expediting shall be included within Contractor's pricing as provided below.
- C. The system cost herein shall include administration/maintenance training for at least ten Owner's representatives with a minimum allotment of three (3) eight hour sessions. All training shall include written and/or video materials that shall remain the property of Owner. If materials are written, they shall be provided in quantities sufficient for each person trained; if materials are video, one copy of each will be required. The administration/maintenance training shall include, but not be limited to, the following:
 - 1. Review of as-built documentation, including a site demonstration.
 - 2. All warranty information.
- D. Minimum standards for maintenance purposes shall include optional access to service on a 24 hour -a-day, 365 day -a-year basis. In addition, Contractor shall, upon notification, respond as follows:
 - 1. Emergency Response: Contractor must respond by utilizing remote diagnostics capabilities (as applicable) within thirty minutes of notification. If necessary, Contractor must dispatch at least one certified technician for arrival on-site within two hours of notification.
 - 2. Non-Emergency Response: Contractor shall respond by utilizing remote diagnostics capabilities and or cause dispatch of at least one certified technician for arrival on-site within one business day of notification.
 - 3. Definition of "Emergency": For maintenance purposes, "emergency" shall be defined as one or more of the following conditions:
 - a. Defects of any riser pairs and/or components involving at least ten percent (10%) of any riser cable's capacity.
 - b. Defects of station cable pairs and/or components involving at least ten percent (10%) of any department or group of voice and/or data stations.

- c. Defects significantly impairing any single attendant console.
- d. Defects of any fiber optic cable and/or components involving at least ten percent (10%) of any department's or group's fiber-based systems and/or stations.
- e. Any pre-defined failure as submitted by Owner and agreed to be Contractor.

3.14 FINAL ACCEPTANCE

- A. The Owner or Owner's representative may visit the site during the installation of the system to ensure that correct installation practices are being followed.
- B. The Owner or Owner's representative will conduct a final job review once the Contractor has finished the job. This review will take place within one week after the Contractor notifies the Owner.
- C. Two copies of all certification data and drawings for all identifications shall be provided to the Owner before the Owner's review.
- D. The Owner or Owner's representative will review the installation and certification data prior to the system acceptance.
- E. The Owner or Owner's representative may test some of the systems features to ensure that the certification data is correct. If a substantial discrepancy is found, the Owner reserves the right to have an independent consultant perform a certification of the entire system. If such a procedure is undertaken, the cost of the testing will be billed back to the Contractor.
- F. In the event that repairs or adjustments are necessary, the Contractor shall make these repairs at his own expense. All repairs shall be completed within 10 days from the time they are discovered.
- G. The Contractor shall provide two (2) copies of an "operating and servicing manual" for the system within fourteen (14) calendar days of Owner's final acceptance of the system. The manuals shall be bound in flexible binders. All data shall be printed material or typewritten. Each manual shall include the following: instructions necessary for the proper operation and servicing of the system; complete as-built installation drawings of the system (11"x17"); equipment specification cut sheets, complete performance test data, complete warrantee information and replacement parts list with current prices listed, contact information for repair and warranty work requests.
 - 1. The Contractor shall mount a full size 30" x 42" bond copy of each scaled Site Plan within MDF room and each IDF room with removable Plexiglas front cover. Frame and cover shall be sized to house the site plan and floor plan drawings. Coordinate location of frame with Owner's Project Manager prior to installation.
 - 2. The Contractor shall hand to the Owner a copy of any applicable installation specific software configurations including all log-in passwords in CD format.
 - 3. Warranty- The entire system shall be warranted free of mechanical or electrical defects for a period of three years after the final acceptance of the installation. Any

material showing mechanical or electrical defects shall be replaced promptly at no additional expense to the District.

END OF SECTION 27 10 01

SECTION 27 41 16 - INTEGRATED AUDIOVISUAL SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL NOTES

- A. This section covers all audiovisual (AV) systems to be installed in the Cafetorium in the Building L at the South El Monte High School, South El Monte, CA. The objective is to provide professional systems, installed, acceptance tested, and ready to use.
- B. Audiovisual Systems Designer herein shall be referred to as Architect.
- C. This written specification section and the TA series drawings shall be collectively referred to herein as the Contract Documents. System features that show up in one part may not be shown in others. In the case of conflict between written specifications and drawings, Contractor must seek written clarification from the Architect. In the event the Contractor fails to obtain such written clarification, the interpretation of the Architect will prevail. Where conflict exists with other specification sections concerning such work or materials, this specification section takes precedence unless otherwise approved in writing by the owner and reviewed by the Architect.
- D. This section includes all labor, materials, equipment, and services necessary to furnish and install the Audiovisual Systems in the Cafetorium in the Building L at the South El Monte High School, South El Monte, CA as shown on the drawings, including but not limited to the following:
 - 1. System components
 - 2. Mounting and rigging hardware and accessories
 - 3. AV cables in conduits
 - 4. Miscellanies terminations and wires
 - 5. Configuration and programming of the audio recording system, Dante audio net-work and associated network switches, amplifiers, DSP's, control system and digital signage system

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract including instructions to Bidders, General and Supplementary Conditions and Division 01 Specification Sections apply to the work of this Section.
 - 1. TA drawings
 - 2. Related Architectural drawings, for reference only
 - 3. Related Electrical drawings, for reference only
 - 4. Related Theatrical drawings, for reference only
 - 5. Related Information Technology drawings, for reference only
- B. Unless otherwise noted, standards, manuals, and codes refer to the latest edition of such standards, manuals, and codes.

C. Referenced Standards

1. ANSI-InfoComm standards (10:2013) Audiovisual Systems Performance Verification
2. AVIXA S601.01:201X Energy Management for Audiovisual Systems (revises ANSI/INFOCOMM 4:2012)
3. AVIXA F501.01:2015 (Formerly INFOCOMM F501.01:2015) Cable Labeling for Audiovisual Systems
4. AVIXA V201.01:201X Projected Image System Contrast Ratio (replaces 3M: 2011)
5. AVIXA A102.01:2017 (Formerly A103.01:2017 Audio Coverage Uniformity in Listener Area
6. ANSI/AVIXA D401.01:201X Standard Guide for Audiovisual Systems Design and Coordination Processes (replace 2M: 2010)
7. AVIXA F502.01:201X Rack Building for Audiovisual Systems
8. AES 67-2015

1.3 SCOPE OF WORK

- A. Remove the existing AV equipment currently in the space. Wrap and box the equipment with protective materials. Coordinate with the Owner Representatives to store the equipment that are to be reused and reinstalled in the new systems. See the system diagrams for the existing equipment to be reinstalled.
- B. Complete System
 1. Provide all described systems complete and working, according to the detailed information contained in the Contract Documents, the omission of minor details notwithstanding.
 2. All system components should be connected and tested in the shop prior to delivery and installation at the project site. Any system functions or equipment which do not work properly during this test must be communicated in writing to the Architect. Repair or replace equipment which is broken, damaged or failing to meet manufacturer's specifications, and retest entire system for proper functioning.
- C. The Audiovisual Contractor shall furnish line-item pricing for Infrastructure and Major Equipment List written in this specification.
- D. Furnish shop drawings and receive approval, prior to fabrication and installation.
- E. Furnish all materials and labor and any engineering services to supply a complete and professionally installed system in working order as described herein. Labor furnished shall be specialized and experienced in audiovisual system installation.
- F. Furnish and install all wire and cable called out in the Contract Documents.
- G. Coordinate all back-box locations with the Electrical Contractor and appropriate general trades.
- H. Furnish any additional items, not specifically mentioned herein, to meet system requirements as specified, without claim for additional payment. Such items may include but are not limited to hardware, transformers, line/distribution amplifiers and other devices for proper installation, interface, isolation, or gain structure.

- I. Perform initial adjustments and verification tests. Submit verification test report to the Architect five days prior to commissioning.
- J. Participate in acceptance testing and perform final adjustments utilizing Audiovisual Contractor furnished test equipment and project engineers.
- K. Furnish and participate in user training.
- L. Furnish system documentation including copies of all relevant drawings and equipment manuals in compliance with the Contract Documents.
- M. Furnish maintenance services for the specified period from the date of acceptance.
- N. Guarantee all new equipment, software, hardware, components, and workmanship for the specified period from the date of acceptance.
- O. Refer to drawing TA0.01 Audiovisual General Notes for the Schedule of Responsibility.

1.4 RELATED WORK SPECIFIED ELSEWHERE

- A. Requirements and materials that apply to the work of others related to audiovisual systems are listed here to define and establish audiovisual system requirements. Coordinate the work of this section with the work of other sections as required in order to maintain satisfactory progress of the work of other sections. Refer to Schedule of Responsibility on drawing TA0.01, unless otherwise noted.
- B. AC Power, and all conduits/containment and cable trays for both AC power and low voltage signals, shall be furnished and installed by Electrical Contractor. All back boxes, floor boxes and pull boxes shall be furnished and installed by Electrical Contractor as indicated in the Schedule of Responsibility on drawing TA0.01 unless otherwise noted.
 - 1. Coordination with the Electrical Contractor is required to assure correct audiovisual conduit/raceway routing, audiovisual backbox locations, and technical power system and receptacle locations as specified in Division 26 – Electrical.
- C. All architectural millwork required in support of the audiovisual systems.

1.5 PROJECT CONDITIONS

- A. All dimensions and equipment locations shall be verified in the field prior to fabrication by the Audiovisual Contractor, who shall make at least one (1) visit to the job site prior to preparation of shop drawings.
- B. Coordinate conduit placement, routing, and separation with the Electrical Contractor to ensure proper installation.
- C. No claims for additional compensation shall be allowed due to the Audiovisual Contractor's misunderstanding of the work involved or lack of a thorough investigation of the job site.

1.6 CONTRACTOR QUALIFICATIONS

- A. To qualify as the Audiovisual Contractor, a contracting firm shall have been, for at least the past five years, in the business of providing systems comparable to those described by the Integrated Audiovisual Systems Contract Documents. Submit with proposal, documentation verifying the AV contractor's experience in fabricating and installing audio-video systems of similar scope and size to that of this project. Contractors not having the requisite applicable experience may be disqualified.
- B. To qualify as the Audiovisual Contractor, a contracting firm shall have factory-trained programmer(s) of the specified integrated control system and the specified audio digital signal processor on staff. Contractors without certified programmer(s) on staff shall contract independent programmer(s) with said training. Submit with proposal, documentation indicating compliance and include name(s) of programmer(s). When using independent programmer(s), the Contractor shall complete the installation with acknowledged programmer(s) or provide a written notification and proposed alternative to the Architect and Owner's Representatives for approval.
- C. To qualify as the Audiovisual Contractor, a contracting firm shall have at least two personnel certified with Dante Level 1, 2 and 3, as well as Dante Domain Manager on staff. Contractor without certified personnel on staff shall contract independent technology specialists with said training. Submit with proposal, documentation indicating compliance, certifications and include names of staff or technology specialists. When using independent technology specialists, the Contractor shall complete the installation with acknowledged specialists or provide a written notification and proposed alternative to the Architect and Owner's Representatives for approval.
- D. To qualify as the Audiovisual Contractor, a contracting firm shall maintain facilities, test equipment and trained technicians for fabricating, installing, and servicing the equipment specified, and have done so for at least the past five years. Said service facility shall be fully staffed with qualified personnel. Contractor shall maintain a parts inventory and stock of "loaner" or rental equipment sufficient to provide, within 24 hours of notification, any necessary in-warranty or out-of-warranty service or equipment replacement to prevent loss of use of the System due to equipment failure.
- E. The list of Audiovisual Contractors below is considered qualified for this project. Other qualified Audiovisual contractors that may bid on the project are subject to approval by the Architect and the Owner. In alphabetic order:
 - 1. 3G Productions
4575 Loma Vista Ave.
Vernon, CA 90058
(562) 692-9201
Contact: David Myers
www.3glp.com
 - 2. Diversified Systems
5627 Stoneridge Drive, Suite 308
Pleasanton, CA 94588
(925) 730-0098
Contact: Tom Yerkes
www.onediversified.com
 - 3. Professional Audio Designs

11629 W Dearbourn Avenue
Wauwatosa, WI 53226
(414) 476-1011
Contact: Kim Leonard
www.proaudiodesigns.com

4. Pro Sound & Video - Los Angeles, California

7401 Laurel Canyon Blvd., Ste 29
N. Hollywood, CA 91605
Tel. 818.765-3800
Fax. 818-765-6304
Contract: Shawn Risberg
www.prosound.net

5. Sound Image

2425 Auto Park Way
Escondido, CA 92029
(760) 737-3900
Contact: Mike Sprague
www.sound-image.com/integration

1.7 CONTRACTOR RESPONSIBILITY

- A. The Audiovisual Contractor shall verify correctness and completeness of materials lists and model numbers prior to bidding and shall assume responsibility for correctness of quantities. If a conflict exists between system drawings and/or written descriptions and/or itemized equipment lists, or if mathematical errors within the Specification result in low equipment totals, the AV Contractor shall provide the higher quantity unless directed by the Architect otherwise.
- B. It shall be the responsibility of the Audiovisual Contractor to furnish and install equipment complete in all respects and to furnish and install any additional equipment required to fulfill the intent of the Contract Documents regardless of whether or not such items are herein specified or indicated without claim for additional payment or costs.
- C. The work specified herein shall be accomplished by a single Audiovisual Contractor who has complete responsibility for the systems described.
- D. The Audiovisual Contractor shall be responsible for coordinating with other trades a complete and suitable installation of electrical isolation equipment to meet the intent of this specification.
- E. No electrical equipment (except approved equipment) shall be located within the Acoustically Sensitive Spaces or installed on walls common to Acoustically Sensitive Spaces. The Audiovisual Contractor shall report all discrepancies between this requirement and the Contract Documents to the Architect and Electrical Engineer prior to installation of such equipment.

1.8 SYSTEM DESCRIPTION AND FUNCTIONAL REQUIREMENTS

A. General programmatic requirements, where applicable:

1. Provide a sound reinforcement and playback system that will serve the following types of program material:
 - a. Program playback to provide prerecorded accompaniment for presentations or performances.
 - b. Speech reinforcement for presentations requiring voice amplification.
 - c. Live sound reinforcement for music performances requiring amplification.
2. Provide a video projection system to support the following program requirements:
 - a. Projecting images of pre-recorded video materials and PowerPoint slides for lecturers, presentations, and performances.
3. Provide the following subsystems to support productions:
 - a. Production Intercom System to maintain production communication during rehearsals, performances, and events.
 - b. Production Audio Monitor/Page System to provide performance audio monitoring to backstage areas, as well as stage manager paging to the backstage areas.
 - c. Assistive Listening System to provide wireless audio amplification for the hearing impaired in compliance with the Americans with Disabilities Act and 2019 CBC 11B-219 and 11B-706.
4. Provide installed cabling and connector panels (Wiring Devices & Junction Boxes) for connectivity to support the program requirements described above and the following:
 - a. Microphone and audio tie-lines to facilitate audio connections throughout the spaces, as shown on the drawings.
 - b. Loudspeaker patching for portable effects and stage-monitor loudspeakers throughout the spaces, as shown on the drawings.
 - c. Video patching to route common analog video formats such as composite video signal; and digital video formats such as SDI, HD-SDI and 3G/6G/12G SDI video signals throughout the spaces, as shown on the drawings.
 - d. AV Data (Shielded Cat 6A) patching to route AV and data signals throughout the spaces, and to connect to the facility-wide data network where allowed.
5. Provide a dedicated Dante audio network for transmitting multiple channels of audio within the specified spaces as noted on the drawings and specification.
6. Provide programming for the integrated control system and all DSP based systems, including the DSP within the amplifiers for the main loudspeaker systems.

B. Cafetorium

1. The Cafetorium will be used for drama performances, musicals, rehearsals, as well as lectures and presentations. The audiovisual systems in this room shall support music and voice reinforcement, audio and video playback, as well as production communication and monitoring.

2. Audio System

a. Microphone and Accessories

- 1) Provide, in the mobile lectern, a podium microphone to support lectures and presentations.
- 2) Provide dedicated ceiling microphones in the room that serve for the Production Audio Monitor/Page System and the Assistive Listening System. Mount the microphone on the dedicated wiring device backbox at the ceiling.
- 3) Provide a 16-channel wireless microphone system to accommodate events.
 - a) Confirm with the manufacturer, frequencies appropriate for use in the project geographical area.
 - b) The system shall...
 - (1) ...be a digital wireless system that is capable of 24-bit processing.
 - (2) ...be capable of automatic channel scan.
 - c) Include wireless body-pack transmitters and wireless handheld transmitters for flexible use.

b. Audio Electronics

- 1) Playback Equipment
 - a) The existing Mac mini shall be the main playback source used at the mix positions to support performances.
- 2) Audio Mixing System
 - a) The audio mixing system shall be utilizing the existing Yamaha TF1 mixer and Tio 1608-D I/O.
 - b) Provide an additional mixing system I/O to support the system I/O capability.
- 3) Digital Signal Processing System (DSP)
 - a) Provide programmable Digital Signal Processing (DSP) System to serve the various systems with independent gain controls, signal delays, cross-over filtering, equalization, and level control for each loudspeaker group as indicated on the drawings, as required for system tuning. The various systems are as follow:
 - (1) Main Loudspeaker System – Left and Right Loudspeakers
 - (2) In-fill Loudspeakers
 - (3) Monitor/Page Loudspeakers in the dressing room
 - (4) Assistive Listening System
 - b) The DSP shall support Dante networked audio protocol and/or AES67 standard.
 - c) The audio system shall be temporarily and automatically silenced when the fire alarm system is activated.
 - d) Design a computer-based technical interface panel, with “Technician” password protection, that allowing technicians and

system administrators ready access to various controls as deemed appropriate through the Submittal process made part of this Specification.

- 4) Amplifier
 - a) Provide 8 channels of amplifier, which includes one existing 2-ch amplifier, in conjunction with the connectivity systems, described hereinafter, to support stage-monitor and effects loudspeakers.
- 5) Provide a rack PC for accessing Dante network control, mixing system and DSP configuration, including the following software:
 - a) Audinate Dante Controller
 - b) QSC Q-Sys Designer
 - c) Yamaha TF Editor
 - d) Shure QLX-D related software
- 6) Provide Ethernet switches that are dedicated for the Dante network audio transmission.
 - a) The Ethernet switches shall be Layer 3, managed switches that support 10/100/1000 Ethernet standards.
 - b) The Ethernet switches shall have fiber-optic interface options.
 - c) The Ethernet switches shall have features including VLANs (Virtual Local Area Network), QoS (Quality of Service) with DSCP, Multicast Filtering and STP (Spanning-Tree Protocol).
 - d) Configure the Ethernet switches according to the manufacturer's recommendations for Dante networked audio.
 - e) Disable 802.3 Energy Efficient (Green) Ethernet function.
 - f) Coordinate with the owner representatives and district IT for installation and configuration.

c. Loudspeaker System

- 1) Main Loudspeakers
 - a) Provide a main left / right loudspeaker system that consists of two single-cabinet, full-range loudspeakers to provide even coverage of sound pressure level for the end stage configuration of the room.
 - b) Mount the loudspeakers to the pipe grid as shown on the drawings.
- 2) In-fill Loudspeakers
 - a) Provide a set of small loudspeakers to deliver in-fill sound coverage for the rear rows.
 - b) Mount the loudspeakers to the pipe grid as shown on the drawings.
 - c) These loudspeakers shall be time delayed with regard to the main loudspeaker system.

3. Video System

a. Video Electronics

- 1) Provide a HDMI extender in the mobile lectern for connecting bright-in HDMI video source, such as a laptop, to support lectures and presentations.
- 2) Provide a network presentation collaboration appliance to support wireless transmission of audio and video via the building network for presentations.
- 3) Provide a presentation switcher/scaler for playback sources routing, switching and image scaling.

b. Video Projection System

- 1) Provide a video projection system to support lectures and presentations with visual materials. The system shall include:
 - a) A lamp free, high-definition (HD) resolution video projector with 7,000 lumens, or higher, color light output.
 - b) A motorized front projection screen.
- 2) The system shall be controlled via the integrated control system.

4. Control System

- a. Provide an integrated control system capable of controlling all basic functions of audio and video equipment, including but not limited to projector, projection screen, video switcher/scaler, DSP and power sequencer.
- b. Provide a button panel user interface for the mobile lectern. This button panel shall the following control functions:
 - 1) System power on/off
 - 2) Projector on/off
 - 3) Projection screen up/down/stop
 - 4) Playback source selection
 - 5) Audio volume and mute controls
- c. Provide a button panel user interface in the dressing room for loudspeaker volume and mute controls.

5. Sub-systems

a. Production Intercom System

- 1) Provide a two-way intercom system for production communication among the technical staff during rehearsals and performances.
 - a) The intercom system shall be 2-channel analog party-line system.
 - b) The stage manager shall be able to communicate on any channel independently or simultaneously.

- 2) The system shall include:
 - a) A system power supply in the AV Rack room.
 - b) A remote station in a portable rack for use within the room.
 - c) A quantity of beltpacks and headsets as specified in the Equipment List.
 - 3) It shall be possible for the stage manager to page into backstage areas using his/her headset at the intercom main station and remote station.
- b. Production Audio Monitor/Page system
- 1) The system shall serve the dressing room with audio program from the Cafetorium.
 - 2) The system shall allow stage manager to page into the backstage area with appropriately loudness regardless of the setting of the volume control in the room.
 - 3) Digital Signal Processing System
 - a) See the Main Digital Signal Processing described in the Audio System above.
 - b) Include matrix mixer(s) for routing audio signals.
 - c) Program the system so that the program audio will be temporary muted for the duration of announcements when paging is initiated.
 - d) Program the system with page override (the local volume controls), for the duration of announcements when paging is initiated. The local volume controls shall control the volume of program audio in the individual space without affecting the volume of page announcements.
 - 4) Loudspeakers
 - a) Provide wall-mounted loudspeakers to serve the spaces indicated on the drawings
 - b) The amplifier and loudspeaker system shall be 70V high impedance system, unless otherwise noted on the drawings.
- c. Assistive Listening System
- 1) Included an FM Assistive Listening System to provide assistance for the hearing impaired.
 - 2) Provide receivers in quantity to comply with the Americans with Disabilities Act and 2019 CBC 11B-219 and 11B-706.
 - 3) Configure the system to use the channel that has the clearest audio for the area served.
 - 4) The antenna shall be mounted at the dedicated panel at the rear of the room as shown on the drawings.
- d. Connectivity System
- 1) Provide infrastructure for audio and video connectivity in support of functions described above. The various signal types include microphone, line-level audio, loudspeaker, video, and AV data (shielded Cat 6A).

- a) Audio Connections
 - (1) Provide audio connections around the space at selected locations to serve as microphone inputs and/or multi-purpose audio interconnection lines.
 - (2) Access to and routing of the audio connections shall be provided via patching facilities where audio connections shall be terminated in the equipment racks as indicated on the drawings.
 - (3) The audio patching equipment, including connectors, cables, patchbays and patch cords, shall support AES/EBU digital audio standard.
- b) Loudspeaker Feeds
 - (1) Provide loudspeaker receptacles for portable sound effects and stage-monitor loudspeakers around the room.
 - (2) Provide a loudspeaker patch panel for routing power amplifier outputs to these receptacles.
 - (3) Include loudspeaker signal splitters in the loudspeaker patch panel.
- c) Video Distribution
 - (1) Provide video jacks at various locations around the room for use with portable video equipment, such as cameras, monitors and video recorders (portable video equipment, NIC.)
 - (2) Provide video-signal patching facilities where the video lines shall be terminated in the equipment racks indicated on the drawings.
 - (3) The video patching equipment, including connectors, cables, patchbays and patch cords, shall support 3G/6G/12G-SDI digital video standard.
- d) AV Data (Shielded Cat 6A) Distribution
 - (1) Provide a system of distributed Category 6A network connectivity at various locations around the room for use as a signal and control transmission system. This system shall be independent from the facility-wide Ethernet distribution.
 - (2) Provide Category 6A patchbay(s) in the equipment racks indicated on the drawings for termination of AV Data tie lines in the areas served.

6. Power Sequencing System

- a. Provide an AC power sequencing system to control the turn-on and turn-off sequence of audio and video electronics to avoid damage and disturbance due to power transients.
- b. The system shall turn on power according to the following order:
 - 1) Source equipment
 - 2) Mixing and routing equipment
 - 3) Amplifiers
- c. The system shall turn off power the reversed order.

- d. The following equipment shall be excluded from the power sequencing system:
 - 1) Control System
 - 2) Ethernet switches
 - 3) DSP
- e. Uninterruptable power supply (UPS) shall be provided for the following:
 - 1) Main Mixing System I/O rack.
 - 2) DSP's
 - 3) Ethernet switches
- f. Submit drawing showing power sequence design for approval by Architect.

C. Digital Signage System

- 1. Provide a digital signage system, which includes a video display and a network media player, at the lobby.
- 2. Coordinate with Owner Representatives for configuring the digital signage system and template.

1.9 SUBMITTALS

A. Pre-bid Submittals:

- 1. Contractors must pre-qualify in order to bid on this project. Contractors must provide proof of the following qualifications and certifications and evidence of experience in similar audiovisual systems installations. Submit listed qualifications to Architect for review ten (10) days prior to submission of a bid. Late submittal will result in exclusion from bid.
 - a. Credential for project manager, project engineer, and lead installer which must include NICET, EST, and/or CTS-I certifications.
 - b. Proof of the AV Contractor's membership in NSCA or AVIXA (Audiovisual and Integrated Experience Association). Indicate if the contractor holds current AVIXA APEX certification.
 - c. Proof that the AV Contractor has been continuously engaged in the installation and service of AV equipment for at least the past five (5) years in systems of similar size, scope, and project type.
 - d. Proof that the AV Contractor holds current certifications necessary to perform Graphic User Interface Programming and Configuration.
 - e. Proof that the AV Contractor has factory-trained programmer(s) of the specified integrated control system and the specified audio digital signal processor on staff and hold the current certifications.
 - f. Proof that the AV Contractor has at least two personnel certified with Dante Level 1, 2 and 3, as well as Dante Domain Manager on staff.

B. Bid Submittals:

- 1. Contractors shall examine all drawings and read all divisions of the specification in order to avoid omissions and duplications and to ensure a complete job. No allowances shall be made for failure to read and understand the Contract Documents. Discrepancies between drawings and the specifications or obvious omissions shall be

referred to the Architect prior to the bid date. Where discrepancies occur and pre-bid instructions have not been obtained, the Contractor agrees to abide by the Architect's decisions.

2. Bid proposals shall include all work and all equipment as specified, as well as any additional equipment and materials not listed here, to be used in assembling the system to fulfill the design intent.
3. The bid submittal shall include the following:
 - a. Infrastructure and Major Equipment List and installation bid.
 - b. Major Equipment List line-item pricing.
 - 1) Installation costs for General Equipment including hardware and labor shall be furnished.
 - 2) Pricing shall include in-bound freight, shipping, and all delivery charges.

C. Shop Drawings Submittals:

1. Within thirty (30) days of contract award, submit the following:
 - a. Milestone Dates
 - 1) Provide schedule of work with milestones for following tasks:
 - a) Submittals complete.
 - b) Shop fabrication complete.
 - c) Shop testing.
 - d) Shipment to site.
 - e) Installation.
 - f) Field testing.
 - g) Training
 - b. Project Personnel
 - 1) Provide in writing, names, mailing address, phone numbers with extensions, email addresses and paging service numbers (if available) of following project personnel:
 - a) Administrative Project Manager.
 - b) Technical Project Manager.
 - c) Service and Installation Manager(s).
 - d) Field Foreman.
 - c. Conduit/Containment Verification
 - 1) Statement confirming that Contractor has reviewed the conduit system as shown on the TA drawings and, where applicable, as built.
 - 2) Notification to Architect, Construction Manager/General Contractor and Electrical Contractor of deficiencies or inadequacies, if any, in conduit system design or installation. If none, so indicate.
2. Prior to equipment purchase, submit the following:
 - a. Equipment list including manufacturer, model number and quantity arranged by room and/or system.

- b. Detailed shop drawings to the Architect for approval. All shop drawings shall be marked with the related drawing number when submitted.
- 3. At a minimum, shop drawings shall include:
 - a. Table of Contents
 - b. Itemized list of all equipment and materials to be used in assembling the system.
 - c. Catalog cut sheet or data sheet for the following:
 - 1) Items with configuration options and model variation. Include indication/markings of configuration and/or options selected.
 - 2) Items required for a functional system, but brand and make are to be selected by the AV contractor.
 - 3) Substitution for discontinued products.
 - d. One-line signal flow diagrams for all sound reinforcement systems, visual systems, and auxiliary systems showing point to point wiring interconnections of all equipment with wire run and wire-tag numbers and patchbay designations. Show all transformers, switches, relays, control circuits, and modifications to equipment. Show all equipment items which are required for realization of the functions described herein.
 - e. Complete lists of all wire run numbers along with the termination location of each end of each wire run.
 - f. Patchbay layouts referenced to system functional diagrams.
 - g. Equipment rack layouts.
 - h. Schematic diagrams for any custom circuitry and all typical connections between audio lines, patchbays, visual system lines and rack mounted equipment.
 - i. Drawings of all items which are to be custom fabricated or modified. Drawing shall be in scale suitable for fabrication. They shall show materials, finishes, hardware, back boxes, connectors, and panel/control markings.
 - 1) Submit samples of lettering/label size and typeface to be employed on custom plates, panels, and other equipment.
 - 2) Submit color options for approval where required.
 - j. Physical arrangement and circuiting of AC power distribution within AV equipment racks.
 - k. Submit samples of custom work, finishes, or other materials as required by the Architect to verify appearance and quality. All costs for shipping samples shall be the responsibility of the Contractor.
 - l. Full size drawings illustrating the physical layout and labeling of patch bays.
 - m. Mechanical drawings of all assemblies, major and sub-assemblies, racks, cabinets, and enclosures, indicating provisions for proper cable management, power management, and thermal management.
 - n. Mechanical drawings showing all proposed mounting details of all major equipment (e.g. loudspeakers, cameras, projectors, video displays, projection screens), and associated rigging and interface with adjacent architecture.
 - o. Vibration and noise control information shall be included and coordinated with the Electrical Contractor.
 - p. Conduit Routing Plan, to be coordinated with electrical contractor prior to cable pull.

- q. Cabling schedule providing information as detailed in AVIXA (formerly known as Infocomm) Standard F501.01:2015 to be coordinated with the Architect and Owner prior to cable pull and termination
- 4. The above listed drawings shall be produced on AutoCAD 2018 min. or similar computer drafting program. Scans or photocopies of the Contract Documents are not acceptable.
- 5. The use of electronic files from other sources (e.g. Architect's backgrounds, Architect's drawings, vendor-supplied panel drawings) shall not absolve the Contractor of the responsibility for ensuring that the Shop Drawings represent a completely engineered coordinated system. The Contractor has final responsibility for providing systems that conform to all requirements in the Contract Documents.
- 6. System installation and fabrication shall not begin without written approval from the Architect.
- 7. Review of shop drawings shall not constitute final approval of system function. Said review does not in any way relieve the Contractor from the responsibility of furnishing material or performing work as required by the Contract Documents.
- 8. Failure of the Contractor to submit shop drawings in ample time for the evaluation shall not entitle the contractor to an extension of contract time, and no claim for extension by reason of such default will be allowed.
- 9. The Contractor shall review Electrical Contractor shop drawings for all vibration and noise control equipment and systems information.
- 10. Prior to equipment installation, submit the following:
 - a. Rigging and Mounting Drawings
 - 1) Details, stamped and signed by an engineer licensed in the State of California, of all equipment mounting methods and materials provided by the Scope of Work, wherein failure of method or materials used for mounting or hanging permanently installed equipment could result in serious personal injury.
 - 2) Details provided by or requiring approval by licensed engineer may include method of attachment to building structure or attachment and/or suspension points; method of attachment to supported equipment; all suspension materials; a materials list including specifications of all suspension materials; calculations used to determine loads and strengths of suspension materials; other as deemed necessary by the engineer.
 - 3) In the absence of submitted approved, stamped and signed mounting and hanging details, the Owner reserves the right to acquire such engineering approval at the expense of the Contractor. Owner will notify Contractor of such intent. Contractor shall remedy within two weeks or Owner may proceed without Contractor approval and without relieving Contractor from any other obligations set forth by Contract.
 - b. DSP files.
 - c. Remote control files for the loudspeaker and/or amplifier systems, where applicable.
 - d. Integrated control system simulation files for the touch panel.
- 11. Proposed Touch Panel Graphical User Interface (GUI) layouts shall be submitted for approval prior to the commencement of control system programming.

12. Prior to scheduling the AV Acceptance Testing visit, submit the following:

- a. Written notice of installation completion.
- b. Initial Adjustments and Verification Test Documentation.

13. Prior to Completion, submit the following:

- a. Notification of completion of Punch List
- b. Outline of training sections
- c. Operating and Maintenance Manuals.
- d. As-Built Drawings.

D. Substitutions:

- 1. Substitutions shall be submitted as per the General Conditions of the Contract Documents.
- 2. The proposed substitutes must be equivalent or superior to the specified products in quality, performance, construction, function, conformance to system objectives and not affect system functionality, signal type, distribution, and features.
- 3. All substitutions must receive the express written consent of the Architect and Owner.
- 4. The Architect reserves the right to substitute new products which become available subsequent to the issuance of the Contract Documents, provided that:
 - a. The contractor has not yet purchased the originally specified equipment.
 - b. The substitute equipment shall not materially increase the Contractor's cost.

1.10 JOB CONDITIONS

- A. Keep the job adequately staffed at all times. Unless illness, loss of personnel, or other circumstances beyond the control of the Contractor intervene, keep the same individual charge throughout.
- B. Cooperate with all appropriate parties in order to achieve well-coordinated progress with overall construction completion schedule and satisfactory results.
- C. Watch for conflicts with work of other contractors on the job and execute, without fair claim for extra payment, moderate moves or changes as are necessary to accommodate other equipment or to preserve acoustic or visual performance, symmetry, and pleasing appearance.
- D. Immediately report to the Architect any design or installation irregularities, particularly architectural elements that interfere with the intended coverage angles of loudspeakers, camera, or projection equipment, so that appropriate action may be taken.
- E. Perform any and all cutting, patching, and painting for proper and finished installation of the system and repair any damage done as a result of such installation.
- F. Audiovisual System work areas are to be maintained in a clean and orderly condition. Clean up and dispose of trash from all audiovisual system work areas.

1.11 ACOUSTICALLY SENSITIVE SPACES

- A. An acoustically sensitive space is defined as a room or space, which requires special construction consideration to meet acoustic isolation, and noise control or vibration control requirements.
- B. The following areas have been designated as "Acoustically Sensitive Spaces":
 - 1. Control Rooms
 - 2. Audiovisual Rack Rooms
 - 3. Electrical Equipment Spaces
 - 4. Mechanical Equipment Spaces
 - 5. Elevator Machine Rooms
- C. All conduit runs penetrating acoustically sensitive spaces shall have both ends sealed by means of removable closed cell neoprene foam after all cables have been run to prevent sound transmission to adjacent spaces.
- D. All audiovisual wiring devices in acoustically sensitive spaces shall have a gasket sealing the faceplate to the back box to prevent sound transmission to adjacent spaces.

1.12 DELIVERY AND HANDLING

- A. The Audiovisual Contractor shall coordinate delivery and installation of all equipment with the Construction Manager and/or Electrical Contractor.
- B. If required by the Construction Manager or Electrical Contractor, audiovisual equipment shall be delivered in a minimum of three (3) separate shipments that shall include:
 - 1. Shipment #1: All items in which conduit is terminated which includes backboxes, wiring device faceplates with receptacles, projection screen cases, etc.
 - 2. Shipment #2: All items which require structural backing such as rigging components, monitor and projector mounts, etc.
 - 3. Shipment #3: All items that are not required until the building/area of work is secure and ready for electronic equipment. This shall include equipment racks, wiring device face plates, portable equipment, etc.
- C. Audiovisual Contractor shall deliver all material to the job site suitably crated, packed, and protected and bearing the label and the nomenclature of the product(s) found in each carton or crate.

1.13 QUALITY ASSURANCE

- A. Parts listed shall be complete and equipment furnished shall conform to manufacturer's specifications.
- B. All materials shall be new and shall conform to the applicable provisions of Underwriter's Laboratories (ULEQ) and American Standards Association (ASA).
- C. Procure and pay for all permits, licenses, and inspections, and observe any requirements stipulated therein. Conform in all trades with all local regulations and codes.

- D. Comply with federal, state, and local labor regulations and applicable union regulations.
- E. Installation shall conform to the latest federal, state, and local electrical safety codes of authorities having jurisdiction, and applicable National Electrical Code, American National Standards Institute and Underwriters' Laboratories, Inc. standards. Where conflict exists, the most stringent code or regulation shall apply.

1.14 GUARANTEE AND SERVICE

- A. The Audiovisual systems shall conform to all applicable code requirements and shall be in conformance with industry standards of operation and practice.
- B. All new systems and components shall be guaranteed free of defects in materials and workmanship for a period of one (1) year from the date of acceptance and shall be repaired or replaced within forty-eight (48) hours following report of such defects by the owner.
- C. Installation of relocated existing equipment shall be guaranteed free of defects in materials and workmanship for a period of one (1) year from the date of acceptance and shall be repaired or replaced within forty-eight (48) hours following report of such defects by the owner.
- D. All audiovisual system software updates shall be automatically issued to the Owner free of charge during the warranty period.
- E. The Contractor shall be available on call and on eight (8) hour notice during the first month following acceptance of the system, to assist the Owner's representatives in any problems which may arise during the initial period of operation.
- F. The Contractor shall provide same day response to service requests, via 24/7 phone support.
- G. If during guarantee period any component is out of service for more than seven (7) consecutive days due to unavailability of parts or service, the contractor shall furnish and install identical new component. If an identical component is not available, the contractor will substitute equivalent equipment with written approval of the owner.
- H. During the course of the guarantee period, the Contractor shall provide a minimum of three (3) service visits to the site for inspection and adjustment of equipment and programming. Contractor shall submit proposed schedule for these visits and shall notify Owner and Architect in writing at least one (1) month in advance of each visit.

1.15 INSURANCE

- A. All equipment and materials shall be fully insured against loss or damage up until acceptance of the system by the Owner or until the Owner relieves the Contractor in writing of this responsibility, whichever is earlier.

PART 2 - EQUIPMENT

2.1 GENERAL

- A. Whenever any equipment is specified by manufacturer and model number, it is for the purposes of establishing a standard of quality, performance, construction, and function.
- B. All materials and equipment shall be new and of the latest design or model offered for sale by the manufacturer.
- C. Equipment models furnished shall operate at the required AC line voltage (i.e. 120 Volts) and frequency (i.e. 60 Hz)
- D. Contractor shall furnish at minimum, quantities as indicated in the Contract Documents as required for complete installation.
- E. For required incidental and miscellaneous products not listed in the Major Equipment List, the AV Contractor shall select products that satisfy the Contract Documents including "System Description and Functional Requirements", "Performance Requirements", Drawings and general product descriptions that follow.
- F. Audiovisual Wire and Cable
 - 1. Approved manufacturers:
 - a. Belden
 - b. Berk-Tek
 - c. Crestron
 - d. Extron
 - e. Gepco
 - f. Liberty
 - g. West-Penn
 - 2. All wire numbers listed in the Contract Documents are Belden unless otherwise noted.
 - 3. Where required, install plenum rated cable listed and labeled for plenum installation.
- G. Electrical Wire and Cable (including ground conductors)
 - 1. Where conflict exists with any codes or ordinances, such codes and ordinances shall take precedence.
 - 2. Where conflict exists with Electrical Specifications, the higher standard or more stringent requirement shall apply.
- H. Wiring Devices
 - 1. Specifications – Duplex Receptacles for Isolated Ground Technical Power
 - a. Grade: Specification, Hubbel IG5362 or equal
 - b. Type: NEMA 5-20R
 - c. Color: Orange
 - d. Marking: Triangle

2. Specifications – Plug Mold
 - a. Grade: Wiremold V/G 2000 Series or equal
 - b. Size: As specified or required.
 3. Specifications – Outlet Strips
 - a. Grade: UL Listed, Wiremold or equal.
 - b. Size: As specified or required.
 4. Approved Manufacturers:
 - a. Waber
 - b. Wiremold
 - c. Hubbell
 - d. Bryant
 - e. GE
 - f. Leviton
- I. Electrical Plates and Panels
1. Specifications – Rack mount panels
 - a. Material: 11-gauge steel or 1/8" aluminum, minimum thickness.
 - b. Finish: Black or to match adjacent equipment.
 - c. Size: 19" wide, standard EIA mounting hole spacing, height as specified or required.
 2. Specifications – Back Box Enclosures
 - a. Material: Code grade steel.
 - b. Finish: Black or Galvanized.
 - c. Size: As specified or required.
 3. Specifications – Plug Box and Termination Panels
 - a. Material: 11-gauge steel or 1/8" aluminum, minimum thickness.
 - b. Finish: Black (unless otherwise noted by the Architect).
 4. Any and all recessed face plates shall have a minimum 3/4" reveal beyond the back box to hide the intersection between the wall material and the back box excluding standard decora-style plates.
 5. Approved Manufacturers
 - a. Hoffman
 - b. Whirlwind
 - c. Pro-Co
 - d. Wireworks
- J. Any equipment to be located outdoors or in damp locations must carry a NEMA 3R rating and be labeled accordingly.

K. Audio Transformers

1. All transformers shall be selected for proper installation and load of the circuits as required by as-built conditions and per manufacturer's recommendations.

L. Control System Programming

1. All control system programming, installation, testing, and debugging to be performed by a manufacturer certified programmer, supplied either directly by the Audiovisual Contractor staff or via a manufacturer authorized and certified independent programmer.
2. Audiovisual Contractor shall furnish complete control system programming, including all source code and on-site coordination, testing, and debugging.
3. Audiovisual Contractor shall furnish all programming of control system equipment including:
 - a. Nightly system shut down.
 - b. Janitorial/Off-hour maintenance control.
 - c. Emergency Life/Safety override, where applicable.
 - d. Audiovisual source and destination equipment selection (e.g. Audio Source, Video Source, Display Selection)
 - e. Audiovisual source equipment transport control (e.g. play, pause, stop, forward, reverse).
 - f. Master volume control
4. In rooms where a volume control system and digital signal processor (DSP) exist, the control system shall be programmed such that:
 - a. The appropriate preset on the DSP system shall be selected based on that activity taking place.
5. Provisions for control from a computer via web interface shall be included.
6. Control system programming shall accommodate future addition of touch panels and mobile applications for Apple iPhone/iPad and Android devices.
7. Coordinate with the Owner Representatives regarding the organization standard requirements of the control page design that are appropriate for the systems.
8. Use animation and graphics where are appropriate to create a clear and professional look and feel to the interface. Design all control pages such that the necessary signal routing to implement the various functions is transparent to the user.
9. All control functions available on the manufacturer's standard handheld remote control should be available in some form via the integrated touch panel control system.
10. Use device control feedback whenever possible to give the user visual feedback that the control signal has been received and processed by the device.
11. Provide all touch panel layouts to Architect for review prior to installing to the system.
12. Provide all touch panel layouts and schedule a meeting with Owner's Representatives to review control system functionality and operational requirements prior to the commencement of work.
13. The touch panel programming will be reviewed after the Owner has used the room long enough to be more familiar with the systems and may require modification. Coordinate with Owner Representatives to schedule the review meeting four months after the owner sign-off of completion of AV system integration.
14. Design the control system with opening page that requires users to enter a User ID or some form of password unless directed by the Owner's Representatives otherwise.

15. Provide a "Help" tab that is always available to presenters. It shall include contact information of an AV Technician or help desk and an IT Technician. Coordinate with Owner's Representatives.
 16. Provide the following controls that are always available to the user:
 - a. Menu Tabs: Provide menu tabs to select each of the main control menus, such as "Audio Control", "Projector Control", "Camera Control", and so on.
 - b. Return: Provide a "Return" button, under each tab to allow user to return to the previous page.
 - c. Home: Provide a "Home" button under each tab to allow use to return to the first page following the setup sequences.
 - d. Program Volume / Mute: Provide a "fader" control object for control of the program audio level. Provide a "mute" button for program audio. It shall return to default settings on start-up.
 - e. System Shutdown: Provide a button for the user to initiate the system shutdown sequencing. This command will generate a warning/confirmation for the user prior to initiating the shutdown sequence. This shutdown sequence should place the AV equipment with long start-up times in "Standby" mode for a short time (ten to fifteen minutes) before powering down. This will avoid a long system start-up sequence if the operator decides to power up the system shortly after turning it off.
 17. Include a warning/confirmation for the user when power down projector button is pressed prior to execute the command.
 18. Other functions as deemed appropriate through the Submittal process made part of this work
- M. Equipment furnished shall be that specified herein.
- N. Detailed performance specifications shall be those published by the manufacture effective on the date of this document for all equipment specified herein.
- O. The Audiovisual Contractor shall verify all projection screen dimensions, surface type, and frame style with the Contract Documents and submit the information with the required shop drawings for approval by the architect prior to ordering any material. Failure to coordinate screen information shall not result in additional costs to the Owner.
- P. The Audiovisual Contractor shall verify all projector lenses for appropriate focal length and intended image size with the Contract Documents, based on field measurements of actual throw distance. Failure to coordinate lens information shall not result in additional costs to the Owner.
- Q. All miscellaneous materials including brackets, pole extensions, mounting hardware, electrical connectors, and other items to properly install the equipment specified shall be included as part of this project whether it is listed or not.
- R. Existing structural mounting to be reused as conditions permit.
- S. If required, Cost Reduction and/or Value Engineering shall be conducted by the Architect and Owner based on final bid amounts.

2.2 MAJOR EQUIPMENT

A. Vendor Quotes:

1. Contractor shall be responsible to coordinate with owner to verify if any manufacturer financial program is appropriate in regard to equipment for this project, as well as the associated soft costs and miscellaneous hardware and cabling costs.

B. Major Equipment List:

1. See Appendix A for the major Equipment list.
2. See Appendix B for the Portable Equipment List.
3. The Major Equipment List itemizes system components and their quantities of the systems as shown in the contract documents. It is the responsibility of the contractor to provide any additional accessories, patch cabling, interfaces, and other miscellaneous equipment not described herein to provide a working system as described in the System Description and Functional Requirements section of this specification, unless otherwise noted as owner furnished or future equipment. For items without specific quantities in the lists, it is the responsibility of the contractor to verify those quantities with the Owner and Architect prior to system installation.

C. Audio Equipment

1. Dante Enabled Devices
 - a. Follow the facility's naming convention for naming the Dante enabled devices. Verify and coordinate with Owner Representatives.
 - b. Set sample rate at 48 kHz for Dante enabled devices.
2. Audio DSP System
 - a. Audio Inputs
 - 1) All system audio inputs shall be programmed with limiters.
 - 2) It shall be possible to matrix any input to any output within the system.
 - b. Audio Outputs
 - 1) All audio outputs shall be programmed with high pass filters, parametric equalization, delay, and limiters.
 - 2) It shall be possible to matrix any input to any output within the system.
 - c. Assistive Listening System (ALS)
 - 1) ALS shall receive the same signal from the house microphones.
 - 2) ALS shall be set up in accordance with ADA requirements.
3. Loudspeaker
 - a. For the ceiling loudspeakers requiring custom colored, following manufactures' special instruction for painting the grille, avoid plugging up the pores on the grille.

- 1) Carefully remove acoustically transparent form, if any, prior to applying the paint.
- 2) Prepare the surface per the paint manufacturer's specification.
- 3) Using "dry roller" to apply multiple thin coats of paint to the grille.
- 4) Avoid build up a lot of paint on the edges of the grille.
- 5) Re-bond the foam to the grille using a light spray-adhesive to avoid audible resonances.
- 6) Do not install loudspeaker grilles prior to receiving Architect's approval of color.

4. Patchbays

- a. Listed as if a single assembly provided by manufacturer. May be assembled from components at contractor's discretion. Follow all normalizing conventions as indicated in drawings, functional descriptions, and according to good engineering practice.
- b. Provide unit-type or harness-type routing to terminal block at contractor's discretion.
- c. For Line-level patchbays, contractor may opt for punchdown, pinned, screwed or soldered connections at his discretion; similarly for Microphone patchbays except, NO punchdowns. (Submit model number for approval by architect).

5. Production Intercom System

- a. Connect the "Announce" output of the remote station to the DSP to allow paging directly from the Production Intercom System headset microphone.
- b. Connect the "Announce" relay output to control the DSP system for the above functionality.
- c. Provide switches, relays and other control hardware required to allow paging to backstage areas and public spaces as shown on the drawings and described in the Specification.

6. Miscellaneous

- a. Provide foam padding for the rack drawers where microphones are stored.

PART 3 - EXECUTION

3.1 INSTALLATION OF SYSTEMS

- A. Locate all apparatus requiring adjustments, cleaning, or similar attention so that it will be accessible for such attention. Equipment racks shall be positioned to permit full access for operation and service.
- B. Furnish and install brackets, braces, and supports. Minimum fastening or support safety factor shall be at least five (5). Design shall be approved by the Architect.
- C. All supporting structures supplied by the Contractor not having standard factory paint finish shall be painted. Paint specifications shall be supplied by the architect or indicated herein.

- D. Provide custom color or finish for any equipment or materials supplied which are exposed to public view. Color and finish of all such equipment or materials shall be approved in writing by the Architect. This does not exclude equipment or materials where standard colors or finishes may be specified herein.
- E. Finish of blank panels and custom assembly panels shall match adjacent equipment panels.
- F. Switches, connectors, jacks, receptacles, outlets, cables, and cable terminations shall be logically and permanently marked. Custom panel nomenclature shall be engraved, etched, or screened. Markings for these items are detailed in the contract documents to ensure consistency and clarity. Verify any changes in working type size and/or placement with the Architect prior to marking.
- G. The equipment specified herein is designed to operate in environments of normal humidity, dust, and temperature. Protect equipment and related wiring where extreme environmental conditions can occur.
- H. Coordinate with millwork fabricator for installation of audiovisual equipment into credenzas, lecterns, etcetera.
- I. Review and coordinate Graphic User Interface Control System appearance and functionality, where applicable:
 - 1. Extron Certified Associate professional license for basic Extron Systems. An Extron Control Professional Certification shall be required for Graphic User Interface (GUI) requiring customized GUI Design.

3.2 CONDUIT

- A. Review and coordinate audio installation with the Electrical Contractor to ensure proper operation of the audio system.
- B. All wiring shall be in conduit unless authorized by the Architect, approved by the Architect in writing, and permitted by code. Exceptions are short runs at equipment terminations where there is no means of connecting conduit to the equipment.
- C. Where installed exposed, conduits shall be parallel with or at right angles to walls or ceiling and /or follow surface contours and shall be supported from walls or ceilings by means of approved clamps or hangers. Conduit connections to equipment racks shall be insulated.
- D. Minimum size conduit shall be trade size 3/4". All conduits shall be sized for maximum 40% fill or less if required by code.
- E. Conduits carrying high voltage or high amperage wiring serving equipment subject to abrupt start-up and possible slapping of wiring within conduit shall not pass through Acoustically Sensitive Spaces.
- F. Conduits connected to dimmer racks or to transformers shall not pass directly into Acoustically Sensitive Spaces. Conduits connected to dimmer racks or transformers shall not penetrate walls, floors, or slabs of Acoustically Sensitive Spaces within thirty (30) feet of those equipment room walls or slabs. All penetrations in the path of conduits within thirty

(30) feet of electrical rooms containing dimmer racks or transformers shall be resilient penetrations.

- G. Large numbers of conduits penetrating walls of Acoustically Sensitive Spaces shall be individually sleeved and shall pass through walls, floors, slabs, and ceilings perpendicularly.
- H. Conduits shall not be installed to connect or contact rigidly other non-electrical equipment or building systems which are vibration isolated.
- I. Coordinate all conduit sizes, locations, and quantities with the Electrical Contractor to provide proper routing, signal separation, and wire group type. Failure to do so shall not allow for additional compensation. Provide a conduit routing plan for approval by the Architect prior to installation. Routing plan shall include intended sizes, separation, and cable fill chart.
- J. Existing conduit and cabling infrastructure to be reused is to be done so to the maximum extent possible without compromising audiovisual system performance.

3.3 RESILIENT PENETRATIONS OF WALLS AND SLABS

- A. All conduit and cable penetrations shall be sleeved, packed, and caulked airtight to form a resilient penetration at the following locations:
 - 1. Mechanical Equipment Rooms
 - 2. Electrical and Dimmer Equipment Rooms
 - 3. Acoustically Sensitive Spaces
 - 4. Rooms with Acoustically Isolated Construction.
- B. Openings shall be oversized and sleeved to provide an inner diameter of one (1) to two (2) inches greater than the outside diameter of the duct or pipe. The conduit shall be centered in the opening and shall not rigidly contact the wall, floor, or ceiling. The resulting gap shall be packed with glass fiber packing material and foam rod. The gap shall be caulked to an airtight seal using permanently flexible acoustical sealant.
- C. Acoustical sleeves may be used in lieu of resilient penetrations described above. Multiple conduit penetrations may be constructed following the detail for multiple penetrations identified in the Contract Documents.

3.4 ELECTRICAL POWER

- A. Review and coordinate electrical power system installation including grounding with the Electrical Contractor to ensure proper operation of the audiovisual system.
- B. Verify that All AC power circuits designated for audio equipment are wired with the correct polarity and ground. Report in writing any discrepancies found to the Architect for corrective action.
 - 1. Provide distribution of electrical power within the equipment racks with a minimum of one space AC receptacle for each four (4) in use per branch circuit.

3.5 STEEL SUPPORTS

- A. Fabricate and install any supports so that the installation does not weaken or overload the building structure. Do not impose the weight of equipment or fixtures on supports provided for other trades or systems. No drilling or cutting of concrete beams, joists, or structural steel, nor welding to structural steel, shall be permitted except as authorized in writing by the Architect.

3.6 SEISMIC RESTRAINTS

- A. All hanging or free-standing equipment and cabinets furnished, including but not limited to racks, loudspeakers, projection screens, and mounts shall be secured to substantial building structures. The equipment described herein shall resist seismic acceleration in any direction up to a limit of the greater of 1.0G or the limit prescribed by the local governing codes.
- B. Loudspeaker hanging details, rack bracing, and other seismic restraints may not be shown on the Contract Documents. The Contractor is responsible for development of these drawings to be submitted and approved by the Structural Engineer.

3.7 BOXES

- A. With the exception of portable equipment, all boxes, conduits, cabinets, equipment, and wiring shall be held in place and the mounting shall be plumb and square.
- B. All boxes shall be securely mounted to building structure. All boxes shall be installed so that wiring contained in them is accessible. Install blanking devices or threaded plugs in all unused holes.
- C. Wiring groups and circuits shall be isolated as indicated herein. Common pull or junction boxes are not permitted except as authorized in writing by the Architect.
- D. Clean all box interiors prior to installing plates, panels, or covers.

3.8 WIRING METHODS AND PRACTICES

- A. Furnish and install all audiovisual wire and cable ensuring proper pulling tension, bend radius, quantities, types, lengths, routing, wire group separation, and identification.
- B. Spare wire runs of each group and type shall be pulled to each termination location. The number of spares shall be ten (10) percent of those in actual use or one, whichever is greater.
- C. Splicing of cables is not permitted between terminations of specified equipment.
- D. Do not pull wire or cable through any box fitting or enclosures where change of raceway alignment or direction occurs; do not bend conductors to less than recommended radius. Employ temporary guides, sheaves, and rollers to protect cables from excess tension, abrasion, or damaging bending during installation.
- E. Use wire pulling lubricants and pulling tensions in accordance with the wire and cable manufacturer's recommendations.

- F. All wires shall be permanently identified at each wire end by marking with adhesive on crimp-on markers and a chart kept of each wire's function. This applies to wire within a rack assembly as well as wire running in conduit.
- G. Wire ends shall be wrapped with appropriate heat shrink tubing. Each shield or drain wire shall be covered with heat shrink to avoid unintentional connections.
- H. Use ring or tongue lugs on all barrier strip terminals. Do not exceed two (2) lugs per terminal. Use crimping tools that are designed for the application or solder. Do not cut strands from conductors to fit lug terminals. Spare terminal blocks, equivalent to ten percent (10%) of those in actual use shall be furnished.
- I. Form in an orderly manner all conductors in enclosures and boxes, wire ways, and wiring troughs, furnishing circuit and conductor identification. Tie using tie wraps of appropriate size and type. Limit spacing between ties to twelve (12) inches and furnish and install circuit and conductor identification at least once in each enclosure.
- J. When the audiovisual cables are pulled, leave a five-foot (5') tail at each end to all field locations and a fifteen-foot (15') tail at all equipment rack locations. Temporary labels shall be applied at both ends of each cable. Permanent labels shall be applied when the cables are cut back and terminated.
- K. All labeling of audiovisual cables shall comply with AVIXA F501.01:2015 (Formerly INFOCOMM F501.01:2015) Cable Labeling for Audiovisual Systems Standard.
- L. The numbering system used in compliance with this standard shall be verified with the owner prior to implementation. A schedule of all cabling and its labels shall be provided to the owner and Architect for review prior to pulling and termination of cables.

3.9 GROUNDING

- A. Audiovisual systems wiring shall conform to the following procedures:
 - 1. Audio equipment AC ground pins shall connect to AC ground.
 - 2. Audio equipment chassis shall connect to rack frames.
 - 3. Audio rack frames shall connect to AC ground bus in panel board by means of #2 gauge (minimum) conductor.
 - 4. Audio shields between AC powered pieces of equipment shall be connected to ground at one end only. Terminate capacitance as required.
 - 5. Audio signal paths between AC powered pieces of equipment shall be connected using balanced lines and/or transformer isolation as required.
 - 6. No unbalanced signal paths may be connected to patchbays.
 - 7. Isolate all audiovisual system wiring from racks, back boxes, and conduit.
 - 8. Isolate all audiovisual system racks from conduit and other conductive surfaces. Use insulated bushings for conduit connections and a dielectric plinth between racks and conductive flooring.
 - 9. AC isolated ground system shall be isolated from all other facility grounds.
- B. All metallic conduit, boxes, and enclosures shall be grounded in accordance with the current California Electric Code (CEC).

- C. Metallic enclosures containing active equipment shall be grounded with due regard for the minimization of electrical noise. This may include the provisions of grounding conductors separate from AC ground.

3.10 EQUIPMENT RACKS

- A. The equipment racks shall be considered as custom assemblies and shall be assembled, wired, and tested in the Contractor's shop. Final assembly of racks shall take place on site after transportation but will conform to the same test results achieved in the shop.
- B. Placement of equipment in equipment racks, as shown in the drawings, is for maximum operator convenience. The insertion of additional equipment not indicated herein or any changes of placement of the equipment must be indicated in writing to the architect before assembly.
- C. Racks shall be installed plumb and square without twists in the frame or variations in level between adjacent racks.
- D. All wire, cable, terminal blocks, rack mounted equipment, and active slots of card frame systems shall be clearly and logically labeled as to their function, circuit, or system. Labeling on manufactured equipment shall be by engraved plastic laminate or by thermal printer on adhesive tape, with white lettering on black background or dark background that is similar to panel finish.
- E. Provide stiffeners to custom panels to prevent panel deformation during normal plugging or switching operations.
- F. All field termination shall enter the rack via a bulkhead panel(s) mounted to the rear-rails of the equipment rack.
- G. All wires and cable used in assembling custom panels and equipment racks shall be formed into harnesses which are tied and supported in accordance with accepted engineering practice.
- H. Harnessed cables shall be combed straight, tie wrapped every eight (8) to twelve (12) inches, and attached to the structure as necessary. Each cable that breaks out from the harness for a termination shall be provided with ample service loop to permit equipment removal from the racks without disconnecting.
- I. Harnessed cables shall be formed in either a vertical or horizontal relationship to equipment, controls components, or terminations.
- J. Cables shields shall be connected to the isolated ground system with due regard for the ground loops.
- K. All system components and related wiring shall be located with due regard from the minimization of induced electromagnetic and electrostatic noise, for the minimization of wiring length, for proper ventilation, and to provide reasonable safety and convenience of the operator.

- L. All rack mounted equipment with front panel controls, shall be furnished with security covers to avoid tampering with preset levels. If specific security covers are not included in the equipment list, the Contractor will furnish the manufacturers suitable alternate.
- M. Every device shall be installed with regard for proper polarity. Absolute polarity shall be maintained through the entire audio chain.

3.11 INITIAL ADJUSTMENT

- A. Verify all circuits and extensions for correct connection, continuity, and polarity. Absolute polarity shall be maintained between all points in the system.
- B. Connector polarity shall be maintained except for terminations at equipment manufactured to other standards. Verify that polarity connections are consistent throughout the system.
- C. Verify that the audio system is operational and the system gain structure is within the recommendations of major component manufacturers.
- D. Verify that all video sources (cameras, players, etc.) and that all video destinations (projectors, displays, recorders, etc.) are sending and receiving video signals. EDID parameters for all digital video devices shall be reviewed with the owner to verify resolution requirements at all video output devices. Confirm all equipment managed by the audiovisual control system can receive and send control signals as applicable, and that all control parameters and functionalities as requested by the owner in the meeting prior to the beginning of work identified in section 2.1.L of this specification have been implemented.

3.12 VERIFICATION TESTS

- A. Confirm that each individual wire and cable run has been labeled and documented in compliance with AVIXA F501.01:2015 (Formerly INFOCOMM F501.01:2015).
- B. Confirm that all system outputs are free of spurious signals including oscillations and radio frequency signals. Contractor shall furnish a wide band oscilloscope in order to verify this condition.
- C. Confirm that the system is free of audible clicks, pops, hums, and other noises when any operating control is activated, with or without an input signal
- D. For all audio and video lines, confirm:
 - 1. Proper circuits appear at each termination location.
 - 2. Proper circuits appear at each jack bay location.
 - 3. Continuity of all conductors.
 - 4. Proper polarity is maintained.
 - 5. Absence of shorts between conductors within each circuit.
 - 6. Absence of shorts between circuit conductors and conduit.
- E. Confirm that the loudspeakers and mountings are free of buzzes and rattles when the speaker is swept with sine wave tones over its rated bandwidth at one-half (1/2) its maximum rated power.

- F. For all permanently mounted loudspeaker terminations, furnish impedance measurement of each pair of loudspeaker lines with all loudspeakers connected and all amplifiers disconnected. These measurements shall be documented in a table listing impedance for each third octave from 20 Hz to 20 kHz and shall be accurate to the nearest 0.1Ω.
- G. For each installed data network cable or fiber optic cable, verify that performance conforms to the relevant TIA/EIA specifications.
- H. For all electronic devices mounted in racks and connected to patch bays confirm:
 - 1. Every audio input and output is balanced.
 - 2. Proper polarity is maintained throughout the entire audio signal path.
- I. Confirm that there are no short circuits between the neutral and isolated ground conductors for each clean power circuit.
- J. Confirm every input and output for video system including:
 - 1. Proper signal to displays.
 - 2. Proper sync to playback and recording equipment.

3.13 VERIFICATION TEST REPORT

- A. Submit five (5) copies of a written report detailing the results of Initial Adjustments and Verification Test including all relevant drawings, charts, test instrument data and photographs. This report shall be completed and submitted to the Architect for review a minimum of five (5) days prior to Acceptance Testing and final tuning. With this report, submit written certification that the installation conforms to the requirements stated herein, is complete in all respects, and is ready for inspection, testing, and tuning.

3.14 ACCEPTANCE TESTING

- A. Acceptance Testing shall be performed by the Architect during a period designated by the Architect. Contractor shall furnish a minimum of two (2) technicians for the acceptance testing period.
- B. All systems shall be compliant with AVIXA (Standard 1M:2009 Uniform Distributed Audio Standard as applicable.
- C. The minimum time required for Acceptance Testing is two (2) working days of dedicated quiet. Coordinate this time period so that free access, work lighting, and electrical power are available on site.
- D. The AV Contractor shall bear any costs incurred for additional Architect's time and expenses due to failure to have the system functioning in accordance with specification requirements at the time scheduled for Architect's Acceptance Testing and Tuning.
- E. Ensure that audiovisual areas are in a clean and orderly condition ready for Acceptance Testing.

- F. At the time of Acceptance Testing, submit one (1) copy of the operation and maintenance manual to the Architect (refer to Paragraph 3.15).
- G. Furnish test equipment meeting the following minimum specifications on site, at all times during the Acceptance Testing. Prior to Acceptance Testing, provide the Architect with a listing of the equipment model numbers and their software versions (if applicable) to be made available.
 - 1. Oscilloscope: 1GHz bandwidth sensitivity – 1mV/cm
 - 2. Digital Multi-meter: 1% accuracy
 - 3. Function Generator: 1GHz bandwidth, distortion <1%
 - 4. Real Time Analyzer: 1/3 octave with microphone.
 - 5. Pink Noise Source: 20 Hz – 20 kHz
 - 6. Impedance Sweep Meter: 20 Hz – 1 kHz range, 1Ω - 50Ω.
 - 7. Polarity Checker: Microphone level, Line Level, and Loudspeaker Level.
 - 8. NTSC bar graphs and other test patterns for video verification.
 - 9. Ultra-high definition (4K60) Video test generator with VGA, DVI, HDMI 2.0, SDI, and 3G-SDI, 6g-sdi and 12G-SDI outputs
- H. Be prepared to verify the performance of any portion of the system by demonstrations, listening, and viewing tests, and instrumented measurements.
- I. Make additional mechanical and electrical adjustments within the scope of the work which may be deemed necessary by the Architect as a result of the Acceptance Test. This may include realigning and re-aiming of video or audio systems, changes in system gain structures, grounding, filtering, or interfaces.
- J. Final acceptance will be contingent upon issuance by the Architect of a letter of acceptance stating that the work has been completed and is in accordance with the Contract Documents. The warranty period will begin upon issuance of said letter.

3.15 SYSTEM DOCUMENTATION

- A. Within fifteen (15) days of the Acceptance Testing, prepare and submit five (5) neatly bound copies of the operations and maintenance manuals to the Owner. Manuals shall be placed in an orderly fashion into a three-ring binder with spine labels indicating contents. These copies are in addition to the one (1) copy furnished to the Architect during Acceptance Testing.
- B. Manual shall include but not be limited to the following:
 - 1. Table of contents
 - 2. Written Guarantee and Service Policy
 - 3. Basic power on/off and operational procedures.
 - 4. List of provided equipment, material, accessories, and loose items including quantities.
 - 5. All Available manufacturer's specification sheets, operation and service literature for each major system component, arranged alphabetically by manufacturer and then by model number.
 - 6. System "As Built" Drawings

- a. Upon completion of the project and final acceptance of the installation, update original drawings to accurately reflect the as-built conditions of all required modifications, executed change orders or other field conditions.
 - b. Provide three copies of the following "As Built" drawings, in pdf format, on CD, DVD or USB media:
 - 1) System functional block diagrams
 - 2) Detailed wiring diagrams including wire tag numbers and wire color codes
 - 3) AV panel elevations
 - 4) Patchbay layouts
 - 5) Rack layouts
 - 6) Terminal block layouts
 - 7) Circuiting of AC power distribution within AV equipment racks
 - 8) AC power sequence layouts
 - 9) Conduit diagrams
 - 10) Conduit-fill schedule diagrams
 - 11) Other relevant drawings as appropriate
 7. A copy of the Verification Test Report
 8. Key Schedule. (i.e., a list of physical keys relating specifically to this project.
 9. Copies of the un-compiled source codes for the integrated control system, if any.
 10. Copies of warranty amendment letters.
 11. Copy of this Specification.
 12. A copy of the final tuning settings as furnished by the Architect
- C. Submit three (3) copies of the above on CD, DVD or USB media. Include all of the above except for, or with the addition of, the following:
1. Do not provide a "Table of Contents". Instead, organize data in folders with clear organization and readily understood file names (e.g.: "Equipment\[manufacturer's name]\[model number]"; "Software\Remote Controls\[room name]\[control system name]", et cetera).
 2. Electronic back up of all software, firmware, and files to restore initial install presets for all applicable devices.
 3. Provide software settings and data files for all computer-controlled equipment.
 4. Include video shot during all training sessions provided to the owner's designated representatives as recorded and edited by the Contractor.
- D. Furnish a framed copy of the as-built signal flow diagram to be mounted in the AV racks. This diagram shall include all cable runs and patch points identified by alphanumeric characters.
- E. Software Passwords
1. Software Password Schedule (i.e., a spreadsheet listing the manufacturer, model number and location in the Facility of each piece of audio-video systems equipment, the software for which is password-protected).
 2. Provide three copies of software passwords as unprotected .pdf files on CD, DVD or USB media.
 3. Provide to Owner's Representative as a secure document separate from Operating and Maintenance Manuals and As-Built Drawings.

F. Source Code Files

1. The Contractor shall provide to the Owner, at the conclusion of acceptance testing, any system source codes, touch panel source material and audio processor files.
2. All electronic files become the property of the Owner and shall be fully functional and able to be modified.
3. Provide three copies of the source code files on CD, DVD or USB media.

3.16 TRAINING

A. The AV Contractor shall provide up to sixteen (16) hours instruction in the safe and proper operation of the systems and equipment provided to the owner's designated representatives.

1. Training and instruction shall be conducted by personnel thoroughly familiar with systems and infrastructure provided.
2. Training and instruction shall include, but not limited to
 - a. Demonstration of purpose for, and operation of, each component and associated infrastructure.
 - b. Review of functional diagrams and owner's manual.
 - c. Demonstration and explanation of operation of system controls and components including functional variations.
3. Instruction, at owner's discretion, may occur in multiple time blocks of less than eight (8) hours each.
4. AV Contractor shall attend at minimally one event involving major use of each specified systems and provision of any helpful suggestions that may be appropriate.

B. The AV Contractor shall provide training sessions to Owner with selected user groups for the following system/equipment in addition to the training sessions above. These training sessions shall be instructed by personnel from the manufacturers or approved training service providers. AV contractor to coordinate with Owner Representatives and manufacturers for scheduling.

1. Digital Signage System
2. Audinate Dante overview and Dante Controller (can be an online session)

C. AV Contractor shall be responsible for making and furnishing video documentation of instruction for future viewing to the Owner.

1. Video documentation can be requested by the owner up to the entire sixteen (16) hours of instruction conducted by the AV Contractor, as well as entire sessions instructed by personnel from the manufacturers as detailed in this section.
2. Video documentation shall be furnished to the owner as individual .mp4 files per training session.
3. Files shall be labeled by the contractor indicating the date of training and a brief description of the content of the video.
4. All files shall be furnished to the owner on a USB storage device provided by the contractor.

D. AV Contractor shall schedule instruction with the owner's designated representatives.

- E. Instruction shall not necessarily follow immediately after the system commissioning.
- F. Instruction shall be independent of the system check-out and activation. Duration of system commissioning shall not affect the length of instruction time.

END OF SECTION 27 41 16

APPENDIX A - AUDIOVISUAL SYSTEMS MAJOR EQUIPMENT LIST

A.1 GENERAL DESCRIPTION

- A. Bidders to confirm all model numbers, quantities and accessories.
- B. Preserve rack space and infrastructure for add alternates, where applicable.
- C. Provide incidentals and accessories, compatible with other equipment, necessary to meet requirements specified herein even though not specifically called out in this specification.
- D. The list below does not include the existing equipment to be re-installed. See system diagrams for those items.
- E. Equipment shall be priced for Education Pricing and discount where available and applicable. Including, but not limited to, Epson, Extron, Sony and Samsung products.

A.2 EQUIPMENT LIST

Manufacturer Basis of Design	Model/Part #	Description	Qty	Notes
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CAFETORIUM

Mircophone and Accessories

Shure	MX418/C	Gooseneck Microphone in Lectern	1	
Shure	A400SMXLR	Shock Mount for Gooseneck Microphone	1	
AKG	PZM11	Ceiling Microphone	2	

Wireless Mircophone and Accessories

Shure	QLXD14	1-ch Wireless Mic Body Pack & Receiver Combo System	14	
Shure	QLXD124/85	1-ch Wireless Mic Body Pack, Handheld & Receiver Combo System	2	
Shure	UA844+ SWB	Active Antenna Splitter	1	

Audio Electronics

Yamaha	Tio1608-D	Audio Mixing System I/O	1	
QSC	Core 110f	DSP	1	
QSC or Crown	CX1102 DCi 2/600	Amplifier (PA1) for Main Loudspeaker	1	
QSC or Crown	CX902 DCi 2/600	Amplifier (PA2) for In-fill Loudspeakers	1	

Manufacturer Basis of Design	Model/Part #	Description	Qty	Notes
QSC or Crown	CX404 DCi 4/300	Amplifier (PA3) for EFX Loudspeakers	1	
QSC or Crown	CX1102 DCi 2/600	Amplifier (PA4)	1	
Cisco	SG350X-48P	Gigabit PoE & PoE+ Managed Ethernet Switch for Dante Network Audio	2	
Dell or HP	Precision or Zcentral w/ dual NIC	Rack PC	1	
Middle Atlantic	RM-KB-LCD17HD	Rack-mount Monitor/Keyboard/Touch Pad	1	

Loudspeaker

Fulcrum Acoustic	GX1226, Black	Main Loudspeaker	2	
Fulcrum Acoustic	YK-GX12, Black	Yoke for Main Loudspeaker	2	
Fulcrum Acoustic	CX826, Black	In-fill Loudspeaker	5	
Fulcrum Acoustic	YK-CX8, Black	Yoke for In-fill Loudspeaker	5	
The Light Source	Mega-Coupler	Rigging Hardware for Loudspeaker	7	
Adaptive Technologies Group or Polar Focus	SC-188-xx-SS	Safety Cable - 3/16" 7x19 Stainless Steel Aircraft Cable w/ (2) 1/4" Shackle	7	Cable length shall be of min slack between U-bracket and pipe grid. AV Contractor to verify length prior to ordering

Video Electronics

Extron	ShareLink Pro 500 Miracast Kit US	Wireless Media Presentation Gateway	1	
Extron	DTP2 T 201 D 60-1741-52	HDMI Extender Tx Wall Plate	1	In Lectern
Extron	IN1808 IPCP SA 60-1615-02	Presentation Switcher/Scaler w/ Control Processor	1	

Video Projection System

Epson	PowerLite L730U	Video Projector w/ Lens	1	
Chief	RPAO-G	Projector Ceiling Mount, TAA Compliant	1	
Chief	CMS Series, Length by AV Contractor	Extension Column	1	
Chief	CMA365	Truss Adapter for Projector Ceiling Mount	1	

Manufacturer Basis of Design	Model/Part #	Description	Qty	Notes
Da-Lite	Tensioned Contour Electrol Image Size: 87"x139" Top Maksing: 2" Surface: HD Progressive 1.1 Seamless on Image Area, Black Backing Control: LVC	Projection Screen	1	

Control System

Extron	EBP 200 60-1389-01	Button Panel in Lectern	1	
Extron	EBP VC1 D 60-1184-01	Button Panel in Dressing Room	1	
Extron	EBDB 60-1170-01	eBus Distribution Hub	1	

Digital Signage

Sony or Samsung	FW-55BZ30J QM55R	Video Display	1	
Sony or Samsung	Protection PLUS P-LM-2N1X57B	5yr Extended Service Plan for Video Display	1	
Chief	LTM1U	Video Display Wall Mount	1	
SpinetiX	HMP300	Digital Signage Player	1	

Production Audio Monitor/Page System

Extron	MPA 601 60-1449-01	Amplifier (PA6)	1	
JBL or Extron	Control 25-1, Pair SM 26T, Pair	Wall-mounted Loudspeaker	1	

Production Intercom System

Clear-Com	PS-702	2-ch Intercom System Power Supply	1	
Clear-Com	RM-702	2-ch Remote Station	1	
Clear-Com	RS-701	Single-Channel Belpack	4	
Clear-Com	CC-300-X4	Single-Ear Standard Headset	5	
Clear-Com	CC-26K-X4	Single-Ear Light Headset	1	

Assistive Listening System

Listen Tech	LA-122	ALS Antenna Kit	1	

Manufacturer Basis of Design	Model/Part #	Description	Qty	Notes
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Audio, Video & Data Patching

Bittree	489-S	AES/EBU Mic/Line-Level Audio Patchbay - 2RU; 2x24 Jacks Mixed Sleeve-Normalled and Not Normalled according to Drawings NO Punch-downs for Mic patchbays	3	Minimum quantities shown, verify with owner if additional / spare cabling to be included and provide pricing option for increased quantities
Custom	by AV Contractor	Loudspeaker Patch Panel	1	
Bittree	75 ohm High-Bandwidth WECO Video Patchbay	HD-SDI Video Patchbay - 2RU; 2x24 or 2x26 Jacks Mixed Normalled and Not Normalled according to Drawings	1	Minimum quantities shown, verify with owner if additional / spare cabling to be included and provide pricing option for increased quantities
Belden	10GX Shielded KeyConnect Patch Panel, 48-port, 2RU	48-Port CAT 6A Network Patchbay - 2RU; 2x24 Ports	2	Minimum quantities shown, verify with owner if additional / spare cabling to be included and provide pricing option for increased quantities
Bittree	LPC 36 02 - 110	36" AES/EBU Audio Patch Cord, Red	20	
Bittree	LPC 36 05 - 110	36" AES/EBU Audio Patch Cord, Green	20	
Whirlwind or ProCo or Gepco or equal	By AV Contractor	36" Loudspeaker Patch Cable	16	
Bittree	VPC3607-75	36" HD-SDI Video Patch Cord, Purple	20	
Belden	10GX Shielded Modular Cord, CAF1106004	36" Cat 6A Shielded Patch Cable, Blue	20	
Bittree	PCHA	Patch Cord Holder - Audio	2	
Bittree	PCHV	Patch Cord Holder - Video	1	

Miscellaneous

Marshall Furniture	EXEC-25FD, Light Oak w/ Wood Mount Box, AC-USB Outlets & Interface Cutouts	Mobile Lectern	1	Contractor to coordinate the Control Button Panel, HDMI Extender Tx & Gooseneck Mic cutouts. Submit shop drawing for approval.
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Manufacturer Basis of Design	Model/Part #	Description	Qty	Notes
Middle Atlantic	SR28-40-32	Equipment Rack (AVR1)	2	
SKB	1SKB-R6U	Portable Stage Manager Rack (AVR2)	1	
Middle Atlantic or Lowell or Chief/Raxxess	U317	Rack Shelf	1	
Middle Atlantic or Lowell or Chief/Raxxess	D3 UDE-314 ESD-3	Rack Drawer	2	
Middle Atlantic or APC or Gator Cases or Tripp Lite	BR1 AR8429 GE-CBLENTBRSH1U SR1UBRUSH	Brush Grommet Panel	2	
NavePoint or Middle Atlantic or equal	00404166	Horizontal Steel Cable Management Raceway	3	
Middle Atlantic or Surgex or APC	UPS-1000R-8 UPS-1000-OL S10BLK	UPS for DSP's and Mixing System I/O	1	
Middle Atlantic or Lowell or Atlas Sound	USC-6R	AC Power Sequencer	1	
Littlite or Middle Atlantic or Furman	RL-10-D-LED LT-GN-PNL RL-LED	Rack Light	1	

END OF SECTION 27 41 16 - APPENDIX A

APPENDIX B - AUDIOVISUAL SYSTEMS PORTABLE EQUIPMENT LIST

B.1 GENERAL DESCRIPTION

- A. Bidders to confirm all model numbers, quantities and accessories.
- B. Bidders shall include line-item pricing for the bid submittal.
- C. Equipment shall be priced for Education Pricing and discount where available and applicable.

B.2 EQUIPMENT LIST

Manufacturer Basis of Design	Model/Part #	Description	Qty	Notes
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PORTABLE EQUIPMENT & SOFTWARE

Wireless Microphone and Accessories

Shure	MX153, Tan	Headworn Microphone	4	
Shure	SB900B	Rechargeable Battery	32	
Shure	SBC800-US	8-Bay Battery Charger w/ Power Supply	2	

Portable Microphone and Accessories

Shure	SM57-LC	Cardioid Dynamic Microphone	2	
Shure	SM58-LC	Cardioid Dynamic Vocal Microphone	2	
Audio-Technica or AKG or Audix	U853Rx CHM 99-Black ADX40-B	Hanging Microphone	4	
ProCo	DB-2	2-ch Passive Direct Box	2	
ProCo	DB-1	1-ch Passive Direct Box	2	
AKG/K&M	KM210/6-Black	Light Duty Collapsible Tripod Base Microphone Stand/Boom 38"-65"	4	
Atlas Sound	CH-1BE	Cable Hook	4	

Portable Loudspeaker and Accessories

Renkus-Heinz	CX41	EFX Loudspeaker	4	
Renkus-Heinz	UBRKT/CF41B	U-Bracket for EFX Loudspeaker	4	
Renkus-Heinz	CX81	EFX Loudspeaker	4	
Renkus-Heinz	UBRKT/CT62-81B	U-Bracket for EFX Loudspeaker	4	
Renkus-Heinz	CX112S	Subwoofer	2	

Manufacturer Basis of Design	Model/Part #	Description	Qty	Notes
The Light Source	Mega-Coupler	Rigging Hardware for Loudspeaker	8	
Adaptive Technologies Group	SC-188-xx-SS	Safety Cable - 3/16" 7x19 Stainless Steel Aircraft Cable w/ (2) 1/4" Shackle	8	

Portable Cables and Adapters

ProCo or Whirlwind or Canare	AES-10 DKF10 DEC010F	Microphone Cables	6	
ProCo or Whirlwind or Canare	AES-25 DEC025F DKF25	Microphone Cables	6	
ProCo or Whirlwind or Canare	AES-50 DKF50 DEC050F	Microphone Cables	2	
ProCo or Whirlwind or Gepco	NL410	10' Loudspeaker Cables (4-conductor)	4	
ProCo or Whirlwind or Gepco	NL425	25' Loudspeaker Cables (4-conductor)	8	
Canare or Gepco or Belden	VAC010F VSD2001 GVC11-BK-10-KB/AB A031694A0310BK	10' Video Cable BNC/BNC	6	
Canare or Gepco or Belden	VAC025F VSD2001 GVC11-BK-25-KB/AB A031694A0325BK	25' Video Cable BNC/BNC	6	
ProCo or Whirlwind or Canare	DURASHIELD-10NBNB	10' Cat6A Cable EtherCon/EtherCon	10	
ProCo or Whirlwind or Canare	DURASHIELD-25NBNB	25' Cat6A Cable EtherCon/EtherCon	10	
Neutrik or Switchcraft or Whirlwind	NA3FF-B	XLR-F/XLR-F Adapter	4	
Neutrik or Switchcraft or Whirlwind	NA3MM-B	XLR-M/XLR-M Adapter	4	
Neutrik or Switchcraft or Whirlwind	NA3JJ	TRS-F/TRS-F Adapter	4	

Manufacturer Basis of Design	Model/Part #	Description	Qty	Notes
Neutrik or Switchcraft or Whirlwind	NA3FP	XLR-F/TRS-M Adapter	4	
Neutrik or Switchcraft or Whirlwind	NA3FJ	XLR-F/TRS-F Adapter	4	
Neutrik or Switchcraft or Whirlwind	NA3MP	XLR-M/TRS-M Adapter	4	
Neutrik or Switchcraft or Whirlwind	NA3MJ	XLR-M/TRS-F Adapter	4	
Neutrik or Switchcraft or Whirlwind	NA2FPMF	XLR-F/RCA-F Adapter	4	
Neutrik or Switchcraft or Whirlwind	NA2FPMM	XLR-F/RCA-M Adapter	4	
Neutrik or Switchcraft or Whirlwind	NA2MPMF	XLR-M/RCA-F Adapter	4	
Neutrik or Switchcraft or Whirlwind	NA2MPMM	XLR-M/RCA-M Adapter	4	
Neutrik or Switchcraft or Whirlwind	NL4MMX	4-Pole SpeakON Coupler	4	
Neutrik	NA2BBNC-D9B	BNC/RCA-F Adapter	4	

Digital Signage

SpinetiX	Elementi X	Digital Signage Content Creation Software	1	

Assistive Listening System

Listen Tech	LR-4200-072	ALS Receiver	12	
Listen Tech	LA-430	Earphone/Neck Loop Lanyard	3	
Listen Tech	LA-401	Ear Speaker	12	
Listen Tech	LA-380	12-Unit Carrying/Charging Case	1	

Miscellaneous

Guard Dog or equal	CPGD3X75-O/B	3-Channel Guardian Cable Protector	1	

END OF SECTION 27 41 16 - APPENDIX B

SECTION 28 31 00 FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Division 26 – Electrical

1.2 DESCRIPTION

- A. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.
- B. The fire alarm system shall be manufactured by an ISO 9001:2008 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994
- C. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof). It's acceptable for peripheral devices to be manufactured outside of the U.S. by a division of the U.S. based parent company.
- D. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.
- E. The installing company shall employ a NICET (minimum Level II Fire Alarm Technology) technician on site to guide the final checkout and to ensure the systems integrity.

1.3 GUARANTY

- A. The fire alarm control panel, voice panels and any head-end equipment shall have a manufacturer's warranty of a minimum of 3 years.

1.4 POST CONTRACT MAINTENANCE

- A. Complete maintenance and repair service for the fire detection system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guaranty.
- B. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, required tests, and list pricing for any replacement products included on the bill of materials, along with the list pricing for products not on the bill of materials; if test and inspection rates are different than full service rates the bid/proposal shall include pricing for all levels for a minimum period of five (5) years Rates and costs shall be valid for the period of five (5) years after expiration of the guar-

anty.

- C. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.

1.5 APPLICABLE STANDARDS AND SPECIFICATIONS

- A. The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.
- B. National Fire Protection Association (NFPA) - USA:

No. 12	Extinguishing Systems (low and high)
No. 12A	Halon 1301 Extinguishing Systems
No. 13	Sprinkler Systems
No. 15	Water Spray Systems
No. 16	Foam / Water Deluge and Spray Systems
No. 17	Dry Chemical Extinguishing Systems
No. 17A	Wet Chemical Extinguishing Systems
No. 2001	Clean Agent Extinguishing Systems
No. 70	National Electric Code
No. 72	National Fire Alarm Code
No. 90A	Air Conditioning Systems
No. 92A	Smoke Control Systems
No. 92B	Smoke Management Systems in Malls, Atria, Large Areas
No. 101	Life Safety Code

- C. Underwriters Laboratories Inc. (UL) - USA:

No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 2572	Mass Notification Systems
No. 217	Smoke Detectors, Single and Multiple Station
No. 228	Door Closers - Holders for Fire Protective Signaling Systems
No. 268A	Smoke Detectors for Duct Applications
No. 521	Heat Detectors for Fire Protective Signaling Systems
No. 464	Audible Signaling Appliances
No. 38	Manually Actuated Signaling Boxes
No. 1481	Power Supplies for Fire Protective Signaling Systems
No. 346	Waterflow Indicators for Fire Protective Signaling Systems
No. 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems
No. 1971	Visual Notification Appliances
No. 2017	Standard for General-Purpose Signaling Devices and Systems
No.60950	Safety of Information Technology Equipment

- D. Local and State Building Codes.
- E. All requirements of the Authority Having Jurisdiction (AHJ).

1.6 APPROVALS

- A. The system shall have proper listing and/or approval from the following nationally recognized agencies:

UL	Underwriters Laboratories, Inc
ULC	Underwriters Laboratories Canada
FM	Factory Mutual
FM 6320	Factory Mutual Gas Detection System
NYFD	New York Fire Department
CSFM	California State Fire Marshal

- B. The system shall be certified for seismic applications in accordance with the California Building Code (CBC). For OSHPD applications in California the system shall be Pre-Approved for seismic applications. The basis for qualification of seismic approval shall be via shake table testing.

1.7 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. The contractor shall prepare electronic installation shop drawing plans, & submittals for review by the Architect and Electrical engineer for review and approval prior to the installation.

The Architect shall deliver to the Fire Alarm Contractor one (1) set of DSA approved drawings for use in creating the installation shop drawings used in construction. These approved sets are to be used for construction purposes.

NOTE: Plans and specifications for the system shall be approved by DSA-Fire & Life Safety prior to system installation.

- B. The following shall be included on Contractor installation shop drawings:
 - 1. Building floor plan of each building drawn to 1/8" scale minimum. Building floor plan shall show location of all devices, conduit and interconnecting wires label circuits and number devices on circuit. Device symbols shall be the same as on the original bid set of drawings. Show all fire rated corridors, occupancy separations and area separation walls. Show all Room Identification Numbers/Use. Indicate candela rating of all visual devices.
 - 2. Site plan showing all buildings, conduit and interconnecting wires, and exterior audible devices.
 - 3. Complete symbol legend (same symbols as bid set), showing all symbols, wire, manufacturer, model number, backbox, mounting height and CSFM Listing Number.
 - 4. Typical mounting height details.
 - 5. Voltage drop using point to point or OHMS Law calculations. Voltage drop shall not exceed 10% per circuit.
 - 6. Battery calculations with batteries used: Normal - 100% for applicable equipment and devices

for a period of 24 Hours. Alarm - 100% for applicable equipment and devices for a period of 15 Minutes.

7. Codes as used in the design of this project.
8. DSA Application Number and District File Number.
9. Classification per site. Ex: Manual, Automatic, etc.
10. Typical fire penetration detail showing methods and codes used.
11. Wiring riser diagram including but not limited to all, devices, wiring, zoning, EOL'S, etc.
12. Sequence of operations schedule/matrix.
13. General notes pertaining to this project.
14. Clearly label circuits.
15. Floor plans showing fire alarm system, complete with all devices, conduit and wiring.
16. Identify all candela rating for visual devices (rating next to the device).

C. The following shall be included in the submittal book:

1. Cover Sheet: Project Name, Project Location, Architect/Engineer of record, System Supplier, System Installer with C-10 License Number and Expiration Date.
2. Table of Contents: Page numbers of all specification sheets and CSFM Listing Numbers.
3. Specification Sheets for each piece of equipment.
4. CSFM Listing Sheets.

1.8 QUALIFICATION OF BIDDERS

- A. To qualify as an acceptable bidder, whether the bid is submitted to the Owner, his agent, a general contractor or a sub-contractor, the system bidder or contractor shall be a qualified fire alarm contractor and shall hold a valid C-10 License issued by the Contractors State License Board of California.

The system bidder or installing contractor shall herein be referred to as the Contractor. The Contractor shall also hold a State of California Consumer Affairs License Bureau of Collection and Investigative Services. This is to ensure that licensed installers familiar with this type of installation will be used on this project. The Contractor shall be the factory authorized distributor (at time of bid), for the brand of equipment being installed. The Contractor shall have been in the business of supplying, installing and servicing Addressable Fire Alarm Systems for the past 5 years, in the State of California.

The Contractor shall be able to refer to at least 20 projects of this nature rendering satisfactory service with contact persons, phone numbers and addresses. The Contractor shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment.

The Contractor shall maintain an inventory of all major components in stock at all times. The Contractor shall maintain on staff for the duration of the project a minimum of one Notifier #NFS2-3030 Certified Installer. Contractors not pre-approved in writing 10 days prior to bid hour and date will not be considered for this project.

- B. The responsibility of the installing Contractor is to provide all drawings, submittals, wire, devices, equipment, installation to conduit system furnished and installed under Division 26, programming, final test out and certification. All specialty Fire Alarm Backboxes for the conduit system provided under Division 26 shall be provided under this section.

- C. Installing Contractor shall be Notifier Distributor and Nesco Affiliated.
- D. Installing Technician shall be a minimum of NICET level II and Project Manager of minimum NICET level III.
- E. Any Network cabling between NODES shall require AMP ND&I certification. Shall be overseen by an RCDD Professional.

PART 2 - PRODUCTS

2.1 MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE

- A. Main FACP or network node shall be a NOTIFIER Model NFS2-640 and shall contain a microprocessor based Central Processing Unit (CPU) and power supply. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.
- B. In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FACP shall perform the following functions:
 - 1. Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
 - 2. Supervise all initiating signaling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.
 - 3. Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.

2.2 SYSTEM CAPACITY AND GENERAL OPERATION

- A. The FACP shall be capable of communicating on Noti-Fire-Net over a Local Area Network (LAN) or Wide Area Network (WAN) utilizing a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mb and support up to 200 panels / nodes per network.
- B. The control panel shall be capable of expansion of up to 10 SLC loops. Each module shall support up to 318 analog/addressable devices for a maximum system capacity of 3180 points.
- C. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 640-character liquid crystal display, individual, color coded system status LEDs, and a QWERTY style alphanumeric keypad for the field programming and control of the fire alarm system. Said LCD shall also support graphic bit maps capable of displaying the company name and logo of either the owner or installing company.

- D. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.
- E. The FACP shall be able to provide the following software and hardware features:
1. Pre-signal and Positive Alarm Sequence: The system shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. In addition, a Positive Alarm Sequence selection shall be available that allows a 15-second time period for acknowledging an alarm signal from a fire detection/initiating device. If the alarm is not acknowledged within 15 seconds, all local and remote outputs shall automatically activate immediately.
 2. Smoke Detector Pre-alarm Indication at Control Panel: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-alarm indication shall be available at the control panel: alert and action.
 3. Alert: It shall be possible to set individual smoke detectors for pre-programmed pre-alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated.
 4. Action: If programmed for Action and the detector reaches a level exceeding the pre-programmed level, the control panel shall indicate an action condition. Sounder bases installed with either heat or smoke detectors shall automatically activate on action Pre-Alarm level, with general evacuation on Alarm level.
 5. The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.
 6. Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.
 7. NFPA 72 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meets the sensitivity testing requirements of NFPA 72.
 8. Programmable Trouble Reminder: The system shall provide means to automatically initiate a reminder that troubles exist in the system. The reminder will appear on the system display and (if enabled) will sound a piezo alarm.
 9. On-line or Off-line programming: The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall also support upload and download of programmed database and panel executive system program to a Personal Computer/laptop. A single change to one CPU database shall not require a database download to other CPUs.
 10. History Events: The panel shall maintain a history file of the last 4000 events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries. The control panels shall also maintain a 1000 event Alarm History buffer, which consists of the 1000 most recent alarm events from the 4000 event history file.
 11. Smoke Control Modes: The system shall provide means to perform FSCS mode Smoke Control to meet NFPA-92A and 90B and HVAC mode to meet NFPA 90A.
 12. The system shall provide means for all SLC devices on any SLC loop to be auto programmed into the system by specific address. The system shall recognize specific device type ID's and associate that ID with the corresponding address of the device.
 13. Passwords and Users: The system shall support two password levels, master and user. Up to 9 user passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.
 14. Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions
 15. Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on

- Occupancy schedules including a Holiday list of up to 15 days.
16. Environmental Drift Control: The system shall provide means for setting Environmental Drift Compensation by device. When a detector accumulates dust in the chamber and reaches an unacceptable level but yet still below the allowed limit, the control panel shall indicate a maintenance alert warning. When the detector accumulates dust in the chamber above the allowed limit, the control panel shall indicate a maintenance urgent warning.
 17. Custom Action Messages: The system shall provide means to enter up to 100 custom action messages of up to 160 characters each. It shall be possible to assign any of the 100 messages to any point.
 18. Local Mode: If communication is lost to the central processor the system shall provide added survivability through the intelligent loop control modules. Inputs from devices connected to the SLC and loop control modules shall activate outputs on the same loop when the inputs and outputs have been set with point programming to participate in local mode or when the type codes are of the same type: that is, an input with a fire alarm type code shall activate an output with a fire alarm type code.
 19. Read status preview - enabled and disabled points: Prior to re-enabling points, the system shall inform the user that a disabled device is in the alarm state. This shall provide notice that the device must be reset before the device is enabled thereby avoiding activation of the notification circuits.
 20. Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen.
 21. Multi-Detector and Cooperating Detectors: The system shall provide means to link one detector with up to two detectors at other addresses on the same loop in cooperative multi-detector sensing. There shall be no requirement for sequential addresses on the detectors and the alarm event shall be a result of all cooperating detectors chamber readings.
 22. ACTIVE EVENT: The system shall provide a Type ID called FIRE CONTROL for purposes of air-handling shutdown, which shall be intended to override normal operating automatic functions. Activation of a FIRE CONTROL point shall cause the control panel to (1) initiate the monitor module Control-by-Event, (2) send a message to the panel display, history buffer, installed printer and annunciators, (3) shall not light an indicator at the control panel, (4) Shall display ACTIVE on the LCD as well as display a FIRE CONTROL Type Code and other information specific to the device.
 23. NON-FIRE Alarm Module Reporting: A point with a type ID of NON-FIRE shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall not affect control panel operation nor shall it display a message at the panel LDC. Activation of a NON-FIRE point shall activate control by event logic but shall not cause any indication on the control panel.
 24. Mass Notification Override: The system shall be UL 2572 listed for Mass Notification and shall be capable, based on the Risk Analysis, of being programmed so that Mass Notification/Emergency Communications events take precedence over fire alarm events.
 25. Security Monitor Points: The system shall provide means to monitor any point as a type security.
 26. One-Man Walk Test: The system shall provide both a basic and advanced walk test for testing the entire fire alarm system. The basic walk test shall allow a single operator to run audible tests on the panel. All logic equation automation shall be suspended during the test and while annunciators can be enabled for the test, all shall default to the disabled state. During an advanced walk test, field-supplied output point programming will react to input stimuli such as CBE and logic equations. When points are activated in advanced test mode, each initiating event shall latch the input. The advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device and wir-

- ing operation/verification.
27. Control By Event Functions: CBE software functions shall provide means to program a variety of output responses based on various initiating events. The control panel shall operate CBE through lists of zones. A zone shall become listed when it is added to a point's zone map through point programming. Each input point such as detector, monitor module or panel circuit module shall support listing of up to 10 zones into its programmed zone map.
 28. Permitted zone types shall be general zone, releasing zone and special zone. Each output point (control module, panel circuit module) can support a list of up to 10 zones including general zone, logic zone, releasing zone and trouble zone. It shall be possible for output points to be assigned to list general alarm. Non-Alarm or Supervisory points shall not activate the general alarm zone.
 29. 1000 General Zones: The system shall support up to 1000 general purpose software zones for linking inputs to outputs. When an input device activates, any general zone programmed into that device's zone map will be active and any output device that has an active general zone in its map will be active. It shall also be possible to use general zone as arguments in logic equations.
 30. 1000 Logic Equations: The system shall support up to 1000 logic equations for AND, OR, NOT, ONLY1, ANYX, XZONE or RANGE operators that allow conditional I/O linking. When any logic equation becomes true, all output points mapped to the logic zone shall activate.
 31. 100 trouble equations per device: The system shall provide support for up to 100 trouble equations for each device, which shall permit programming parameters to be altered, based on specific fault conditions. If the trouble equation becomes true, all output points mapped to the trouble zone shall activate.
 32. Control-By-Time: A time based logic function shall be available to delay an action for a specific period of time based upon a logic input with tracking feature. A latched version shall also be available. Another version of this shall permit activation on specific days of the week or year with ability to set and restore based on a 24 hour time schedule on any day of the week or year.
 33. Multiple agent releasing zones: The system shall support up to 10 releasing zones to protect against 10 independent hazards. Releasing zones shall provide up to three cross-zone and four abort options to satisfy any local jurisdiction requirements.
 34. Alarm Verification, by device, with timer and tally: The system shall provide a user-defined global software timer function that can be set for a specific detector. The timer function shall delay an alarm signal for a user-specified time period and the control panel shall ignore the alarm verification timer if another alarm is detected during the verification period. It shall also be possible to set a maximum verification count between 0 and 20 with the "0" setting producing no alarm verification. When the counter exceeds the threshold value entered, a trouble shall be generated to the panel.

F. Network Communication

1. The FACP shall be capable of communicating on Noti-Fire-Net over a Local Area Network (LAN) or Wide Area Network (WAN) utilizing a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mb and support up to 200 panels/nodes per network.

G. Central Processing Unit

1. The Central Processing Unit shall contain and execute all control-by-event (including Boolean functions including but not limited to AND, OR, NOT, ANYx, and CROSSZONE) programs for

specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.

2. The Central Processing Unit shall also provide a real-time clock for time annotation, to the second, of all system events. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.
3. The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.
4. The CPU shall provide an EIA-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.
5. The CPU shall provide two EIA-485 ports for the serial connection to annunciation and control subsystem components.
6. The EIA-232 serial output circuit shall be optically isolated to assure protection from earth ground.

H. Display

1. The system display shall provide a 640-character backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide eleven Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM, SECURITY, SUPERVISORY, SYSTEM TROUBLE, OTHER EVENT, SIGNALS SILENCED, POINT DISABLED, CONTROLS ACTIVE, and CPU FAILURE.
2. The system display shall provide a QWERTY style keypad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels with up to ten (one Master and nine User) passwords shall be accessible through the display interface assembly to prevent unauthorized system control or programming.

I. Loop (Signaling Line Circuit) Control Module:

1. The Loop Control Module shall monitor and control a minimum of 318 intelligent addressable devices. This includes 159 intelligent detectors (Ionization, Photoelectric, or Thermal) and 159 monitor or control modules.
2. The Loop Control Module shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU.
3. Each SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.
4. The SLC interface board shall receive analog or digital information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular device. Each SLC Loop shall be isolated and equipped to annunciate an Earth Fault condition. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and the automatic determination of detector maintenance requirements.

J. Addressable Charger Power Supply

1. The auxiliary addressable power supply is a remote 24 VDC power supply used to power Noti-

- fication Devices and field devices that require regulated 24 VDC power; NOTIFIER model # ACPS-610
2. The addressable power supply for the fire detection system shall provide up to a minimum of 6.0 amps of 24 volt DC regulated power for Notification Appliance Circuit (NAC) power or 10.0 amps of 24 volt DC general power. The power supply shall have an additional 0.5 amp of 24 VDC auxiliary power for use within the same cabinet as the power supply. It shall include an integral charger designed to charge 12 - 200 amp hour batteries.
 3. The addressable power supply shall provide four individually addressable Notification Appliance Circuits that may be configured as Class "A" or Class "B" circuits. All circuits shall be power-limited per UL 864 requirements.
 4. The addressable power supply shall provide built-in synchronization for certain Notification Appliances on each circuit without the need for additional synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.
 5. The addressable power supply shall operate on 120 or 240 VAC, 50/60 Hz.
 6. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means. Power supplies that do not use an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire.
 7. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.
 8. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of zero, two, eight or sixteen hours shall be programmable.
 9. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be programmable.
 10. The addressable power supply mounts in either the FACP backbox or it's own dedicated surface mounted backbox with cover.
 11. Each of the power supply's four output circuits shall be programmed- for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.
 12. The addressable power supply's output circuits shall be individually supervised when they are selected to be either a Notification Appliance Circuit when wired Class "A" or by the use of and end-of-line resistor. When the power supply's output circuit is selected as General 24 VDC power, the circuit shall be individually supervised when an end-of-line relay is used.
 13. When selected for Notification Appliance Circuits, the output circuits shall be individually programmable for Steady, March Time, Dual Stage or Temporal.
 14. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.
 15. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.
 16. An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

K. Remote Transmissions:

1. Provide local energy or polarity reversal or trip circuits as required.
2. The system shall be capable of operating a polarity reversal or local energy or fire alarm transmitter for automatically transmitting fire information to the fire department.
3. Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator's terminals, system printers and annunciators.
4. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

L. Field Programming

1. The system shall be programmable, configurable and expandable in the field without the need for special tools, laptop computers, or other electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.
2. It shall be possible to program through the standard FACP keyboard all system functions.
3. All field defined programs shall be stored in non-volatile memory.
4. Two levels of password protection shall be provided in addition to a key-lock cabinet. One level shall be used for status level changes such as point/zone disable or manual on/off commands (Building Manager). A second (higher-level) shall be used for actual change of the life safety program (installer). These passwords shall be five (5) digits at a minimum. Upon entry of an invalid password for the third time within a one minute time period an encrypted number shall be displayed. This number can be used as a reference for determining a forgotten password.
5. The system programming shall be "backed" up via an upload/download program, and stored on compatible removable media. A system back-up disk shall be completed and given in duplicate to the building owner and/or operator upon completion of the final inspection. The program that performs this function shall be "non-proprietary", in that, it shall be possible to forward it to the building owner/operator upon his or her request.
6. The installer's field programming and hardware shall be functionally tested on a computer against known parameters/norms which are established by the FACP manufacturer. A software program shall test Input-to-Output correlations, device Type ID associations, point associations, time equations, etc. This test shall be performed on an IBM-compatible PC with a verification software package. A report shall be generated of the test results and two copies turned in to the engineer(s) on record.

M. Specific System Operations

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 0 to 60 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

N. System Point Operations:

1. Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or video terminal.
2. System output points shall be capable of being turned on or off from the system keypad or the video terminal.
3. Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:
 - a. Device Status.
 - b. Device Type.
 - c. Custom Device Label.
 - d. Software Zone Label.
 - e. Device Zone Assignments.
 - f. Analog Detector Sensitivity.
 - g. All Program Parameters.
4. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 4000 system events. Each of these events will be stored, with time and date stamp, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed; one event at a time, and the actual number of activations may also be displayed and or printed. History events shall include all alarms, troubles, operator actions, and programming entries.
5. The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.
6. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.
7. If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
8. The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personal when a detector is at 80% of its alarm threshold in a 60 second period.

O. Audio Amplifiers

1. The Audio Amplifiers will provide Audio Power (@25 Volt RMS or 70 RMS) for distribution to speaker circuits.
2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).
3. The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators for the following conditions:
 - a. Earth Fault on DAP A (Digital Audio Port A)
 - b. Earth Fault on DAP B (Digital Audio Port B)
 - c. Audio Amplifier Failure Detected Trouble
 - d. Active Alarm Bus input
 - e. Audio Detected on Aux Input A

- f. Audio Detected on Aux Input B
 - g. Audio Detected on Firefighter's Telephone Riser
 - h. Receiving Audio from digital audio riser
 - i. Short circuit on speaker circuit 1
 - j. Short circuit on speaker circuit 2
 - k. Short circuit on speaker circuit 3
 - l. Short circuit on speaker circuit 4
 - m. Data Transmitted on DAP A
 - n. Data Received on DAP A
 - o. Data Transmitted on DAP B
 - p. Data Received on DAP B
 - q. Board failure
 - r. Active fiber optic media connection on port A (fiber optic media applications)
 - s. Active fiber optic media connection on port B (fiber optic media applications)
 - t. Power supply Earth Fault
 - u. Power supply 5V present
 - v. Power supply conditions - Brownout, High Battery, Low Battery, Charger Trouble
4. The audio amplifier shall provide the following built-in controls:
- a. Amplifier Address Selection Switches
 - b. Signal Silence of communication loss annunciation Reset
 - c. Level adjustment for background music
 - d. Enable/Disable for Earth Fault detection on DAP A
 - e. Enable/Disable for Earth Fault detection on DAP A
 - f. Switch for 2-wire/4-wire FFT riser
5. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.
6. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).
7. System shall be capable of backing up digital amplifiers.
8. One-to-one backup shall be provided by either a plug-in amplifier card or a designated backup amplifier of identical model as the primary amplifier.
9. One designated backup amplifier shall be capable of backing up multiple primary amplifiers mounted in the same or adjacent cabinets.
10. Multi-channel operation from a single amplifier shall be supported by the addition of an optional plug-in amplifier card.
- P. Audio Message Generator (Prerecorded Voice)/Speaker Control:
- 1. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a prerecorded voice message to all speakers in the building.
 - 2. Actuation of any alarm initiating device shall cause a prerecorded message to sound over the speakers. The message shall be repeated four (4) times. Pre- and post-message tones shall be supported.
 - 3. A built-in microphone shall be provided to allow paging through speaker circuits.
 - 4. System paging from emergency telephone circuits shall be supported.
 - 5. The audio message generator shall have the following indicators and controls to allow for proper operator understanding and control:

- a. Lamp Test
- b. Trouble
- c. Off-Line Trouble
- d. Microphone Trouble
- e. Phone Trouble
- f. Busy/Wait
- g. Page Inhibited
- h. Pre/Post Announcement Tone

2.3 SYSTEM COMPONENTS

A. Communicators

1. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status. Systems that utilize relay contact closures are not acceptable.
2. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to two different telephone numbers.
3. The UDACT shall be capable of transmitting events in 4+2, SIA, and Contact ID.
4. Communication shall include vital system status such as:
 - a. Independent Zone (Alarm, trouble, non-alarm, supervisory)
 - b. Independent Addressable Device Status
 - c. AC (Mains) Power Loss
 - d. Low Battery and Earth Fault
 - e. System Off Normal
 - f. 12 and 24 Hour Test Signal
 - g. Abnormal Test Signal (per UL requirements)
 - h. EIA-485 Communications Failure
 - i. Phone Line Failure
5. The UDACT shall support independent zone/point reporting when used in the Contact ID format. In this format the UDACT shall support transmission of up to 3,064 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.
6. The UDACT shall be capable of being programmed with the same programming utility as the host FACP, and saved, edited and uploaded and downloaded using the utility. UDACT shall be capable of being programmed online or offline. The programming utility shall also support upgrading UDACT operating firmware.
7. The UDACT shall be capable of generating Central Station reports providing detailed programming information for each point along with the central station point address.
8. An IP or IP/GSM Communicator option shall be available to interface to the UDACT and be capable of transmitting signals over the internet/intranet or Cellular (GSM) network to a compatible receiver.

2.4 GATEWAY & WEBSERVER OPTIONS

- A. Common Alerting Protocol (CAP) Gateway: The system shall support an optional CAP Gateway (Common Alerting Protocol). The CAP Gateway translates fire system messages to industry standard CAP messages for integration with CAP-compliant clients. A CAP gateway shall be available from the fire alarm control panel manufacturer.
- B. LEDSIGN Gateway: The system shall support an optional and proprietary LEDSIGN Gateway to interface to LED signs that will automatically display emergency messages. The signs shall be capable of storing up to 100 messages that can be activated via system programming with the ability to be manually overridden. The Sign Gateway shall support up to 10 independent signs, each sign capable of playing an independent message. Multiple LEDSIGN Gateways can be used in network applications. An LEDSIGN gateway shall be available from the fire alarm control panel manufacturer.
- C. BACnet Interface Gateway: The system shall be capable of being interfaced with BACNet compliant clients. A BACnet interface supporting BACnet/IP communication shall be available from the fire alarm control panel manufacturer.
- D. MODbus Interface Gateway: The system shall be capable of being interfaced with MODbus compliant clients. A MODbus interface supporting MODbus/TCP communication shall be available from the fire alarm control panel manufacturer.
- E. Noti-Fire-Net Gateway: The system shall support an IP based gateway to enable the panel or local Noti-Fire-Net to be connected to an ONYXWorks workstation via the Internet or Intranet. This gateway shall also support the ability to integrate the system to an interactive firefighter's display. The Noti-Fire-Net Gateway shall be available from the fire alarm control manufacturer.
- F. Webserver: The system shall support a webserver allowing remote connection via the Internet or Intranet. Authorized users will have the ability to view panel/network history, event status and device properties. The webserver shall also support sending event information via email or text to up to 50 registered users, the webserver shall be available from the fire alarm control panel manufacturer.
- G. Web Portal Interface: The system shall be capable of being interfaced with a web portal to integrate with Inspection and Service Manager utilities. The web portal and inspection and service manager utilities shall be available from the fire alarm control panel manufacturer.

2.5 SYSTEM COMPONENTS - ADDRESSABLE DEVICES

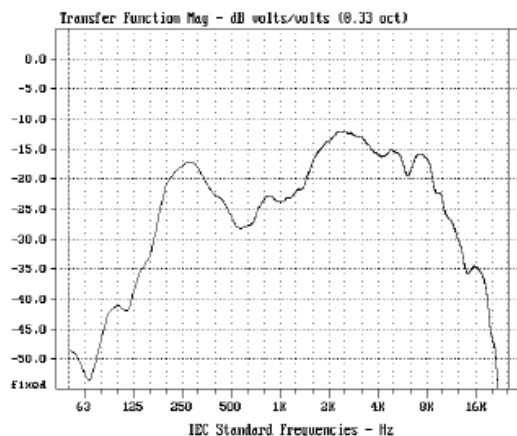
- A. Addressable Devices - General
 - 1. Addressable devices shall provide an address-setting means using rotary decimal switches. Addressable devices that require the address be programmed using a programming utility are not an allowable substitute. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.
 - 2. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute. Addressable devices that require the address be pro-

- grammed using a special tool or programming utility are not an allowable substitute.
3. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuits.
 4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
 5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.
 6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72.
 7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base options shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications. The system shall also support an intelligent programmable sounder base, the programmable sounder base shall be capable of providing multiple tones based on programming and at a minimum be capable of providing a Temp-4 tone for CO (Carbon Monoxide) activation and a Temp-3 tone for fire activations and be capable of being synchronized with other programmable sounder bases and common area notification appliances; 85 DBA minimum.
 8. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
 9. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
 10. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.
 11. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.
 12. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.
- B. Intelligent Photoelectric Smoke Detector: The intelligent photoelectric smoke detector shall be NOTIFIER model # FSP-851 and shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.
- C. Intelligent Thermal Detectors: The intelligent thermal detectors shall be NOTIFIER FST- series addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. A high heat thermal detector rated at 190 degrees Fahrenheit shall also be available. The thermal detectors shall connect via two wires to the fire alarm control panel signaling line circuit.
- D. SpectrAlert Advance Speakers

1. The Speaker appliance shall be System Sensor SpectrAlert Advance model Speaker. The speaker shall be listed to UL 1480 for Fire Protective Signaling Systems. It shall be a dual-voltage transformer speaker capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.
2. A universal mounting plate shall be used for mounting ceiling and wall speaker products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate.
3. Speakers shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker design shall isolate speaker components to reduce ground fault incidents.
4. The speaker shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction.
5. All notification appliances shall be backward compatible

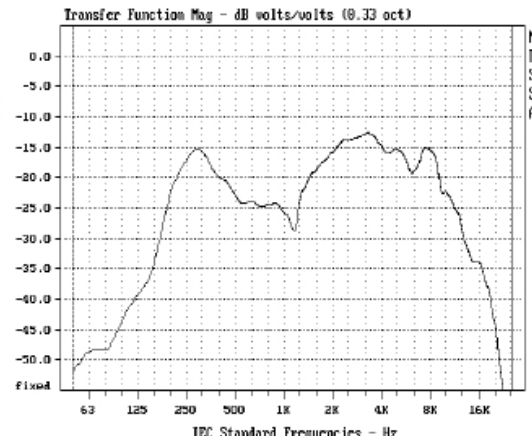
Ceiling Speaker

Wide Band Frequency Response



Wall Speaker

Wide Band Frequency Response



Note: The wide band frequency response is derived using MLS methods

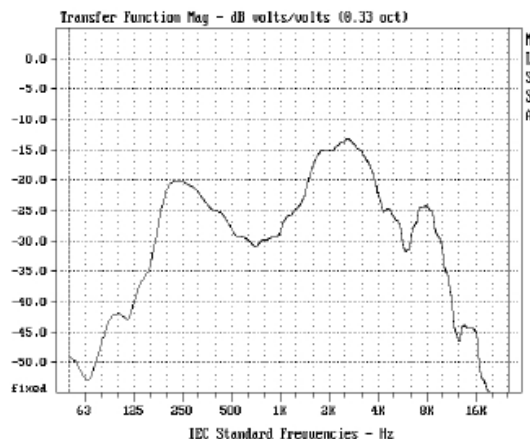
E. SpectrAlert Advance Speaker Strobes

1. The Speaker Strobe appliance shall be System Sensor SpectrAlert Advance model Speaker Strobe. The speaker strobe shall be listed to UL 1971 and UL 1480 and be approved for fire protective signaling systems. It shall be a dual-voltage transformer speaker strobe capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.
2. A universal mounting plate shall be used for mounting ceiling and wall speaker strobe products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate. Also, SpectrAlert Advance speaker strobes and the Sync•Circuit™ Module MDL3 accessory, if used, shall be powered from a non-coded notification appliance circuit

- output and shall operate on a nominal 12 or 24 volts (includes fire alarm panels with built in sync). When used with the Sync•Circuit Module MDL3, 12-volt rated notification appliance circuit outputs shall operate between 8.5 and 17.5 volts; 24-volt rated notification appliance circuit outputs shall operate between 16.5 to 33 volts. If the notification appliances are not UL 9th edition listed with the corresponding panel or power supply being used, then refer to the compatibility listing of the panel to determine maximum devices on a circuit.
3. Speaker strobes shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker strobe design shall isolate speaker components to reduce ground fault incidents.
 4. The speaker strobe shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction. The strobe shall consist of a xenon flash tube with associated lens/reflector system and operate on either 12V or 24V. The strobe shall also feature selectable candela output, providing options for 15 or 15/75 candela when operating on 12V and 15, 15/75, 30, 75, 110, or 115 when operating on 24V. The strobe shall comply with NFPA 72 and the Americans with Disabilities Act requirement for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range.
 5. All notification appliances shall be backward compatible.

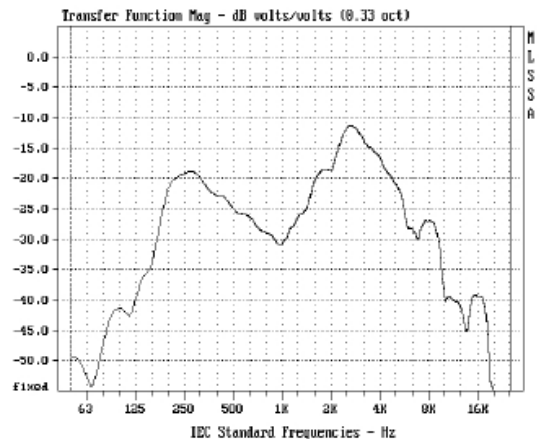
Ceiling Speaker Strobe

Wide Band Frequency Response



Wall Speaker Strobe

Wide Band Frequency Response



Note: The wide band frequency response is derived using MLS methods

6. Strobe lights shall meet the requirements of the ADA, UL Standard 1971 and be fully synchronized.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the CEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
- B. All conduit, junction boxes, conduit supports, and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
- C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.

3.2 TEST

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72 in the presence of the Inspector of Record (IOR) and the Owner.

- A. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
- B. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
- C. Verify activation of all waterflow switches.
- D. Open initiating device circuits and verify that the trouble signal actuates.
- E. Open and short signaling line circuits and verify that the trouble signal actuates.
- F. Open and short notification appliance circuits and verify that trouble signal actuates.
- G. Ground all circuits and verify response of trouble signals.
- H. Check presence and audibility of tone at all alarm notification devices.
- I. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
- J. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
- K. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification

functionality and similar.

3.3 FINAL INSPECTION

- A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.4 INSTRUCTION

- A. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.
- B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."
- C. Provide the NFPA certificate to the owner, local fire official, Architect and DSA.

END OF SECTION 28 31 00

SECTION 31 10 00 – SITE CLEARING AND DEMOLITION

PART 1 - GENERAL

All applicable portions of Division 1, including the drawings and general provisions of the contract, the general and supplementary conditions and Division 1 specifications sections which apply to work of this section as if printed herein.

The following are minimum requirements and shall govern, except that all local, state and/or federal codes and ordinances shall govern when their requirements are in excess hereof.

- 1.1 SECTION INCLUDES: Description of requirements for materials, fabrications, and installation Site Clearing and Demolition and associated accessory items including, but not necessarily limited to, the following:
 - 1.1.1 Work includes clearing and grubbing of the site, including the removal of debris, vegetation, foreign objects, existing asphaltic, rock outcrops, rocks, removal and or relocation of underground utilities from the site as shown on the documents, and or as indicated on the drawings.
 - 1.1.2 Grading, stripping and stock piling of topsoil.
- 1.2 RELATED WORK:
 - 1.2.1 Section 015723 – Storm Water Pollution Prevention Plan
 - 1.2.2 Section 312200 – Earthwork: Dust suppression and project conditions
 - 1.2.3 Cap and identify utilities where required.
 - 1.2.4 Remove and/or relocate underground utilities as shown or required on the civil, offsite drawings, plumbing, electrical drawings and architectural drawings.
- 1.3 QUALITY ASSURANCE:
 - 1.3.1 Comply with applicable portions of 2019 CBC (CCR Title 24, Part 2), Chapter 33.
 - 1.3.2 Comply with applicable portions of 2019 CFC (CCR Title 24, Part 9), Chapter 33.
 - 1.3.3 Where the requirements of applicable codes and regulations conflict with the requirements of this Specification, comply with the more stringent provisions.
 - 1.3.4 Obtain and pay for any permits, bonds, licenses, etc., required for Site Clearing and Removal Work to include all truck hauling bonds or permits.
 - 1.3.5 All clearing and removal work shall be accomplished in strict accordance with all local and state building codes, requirements, and regulations, including but not limited to noise abatement, dust control, classification of disposal materials, haul route conditions, etc. and coordination with the adjacent developers with their offsite improvements and schedules of operations.
- 1.4 JOB CONDITIONS:

- 1.4.1 An attempt has been made to show all existing structures, utilities, drives, pavements, rock out crops, curbs, walks, etc., in their approximate location on the survey and/or on the drawings. However, others that are not shown may exist and may be found upon visiting the site or during the clearing and removal work. It will be the responsibility of this Contractor to accurately locate all existing facilities and to determine their extent. If such facilities obstruct the progress of the work and are not indicated to be removed or relocated, they shall be removed or relocated only as directed by the Owner and/or Architect.
 - 1.4.1.1 Report any existing site element not shown on the drawings to the Civil Engineer of Record and Architect so that the proper dispensation of the element may be made.
- 1.4.2 Site is not a cut/fill balance. The Contractor shall review the plans and provide calculations to determine the extent of the import or export requirements for the job and pay all associated costs to include: Haul route fees or bonds, any plans/documents as required by the local authority for approved haul route and disposal.
- 1.4.3 Natural features, existing structures, existing landscaping, existing utilities, etc., which are indicated to remain on the drawings and specifications shall be protected and shall not be defaced or damaged in any manner. Provide protective barriers, markers, fencing to protect any existing natural or manmade features and the Contractor shall maintain such device(s) for the duration of the project or as directed by the Architect to remove such protective device(s).
- 1.4.4 Restore to their present conditions any pavement in the public right-of-way that is disturbed by the work under this section. All pavement restoration work in public rights-of-way shall be performed to the full satisfaction of the governmental agencies having local jurisdiction. See Sections 321216 and 321600 for all pavement requirements.
- 1.4.5 Conform to the requirements of Sections 312200, 312219 and 312300.
- 1.5 ENVIRONMENTAL REQUIREMENTS:
 - 1.5.1 Noise producing activities shall be held to a minimum. Internal combustion engines and compressors, etc., shall be equipped with mufflers to reduce noise to a minimum. Comply with all noise abatement ordinances.
 - 1.5.2 Keep all areas within the clearing and removal area sufficiently dampened to prevent dust from rising due to clearing or removal operations. Comply with all anti-pollutions ordinances. All dust prevention control and anti-pollution control shall be done on a daily basis and/or as directed by the **ARCHITECT**.
 - 1.5.2.1 This Contractor shall see to it that trucks leaving the site shall not do so in such a manner that debris, vegetation, mud, and earth will not be deposited on adjacent street pavements. **Any debris, vegetation, mud, or earth deposited on street pavements shall be promptly removed by this Contractor on a continuous basis and/or as directed by the ARCHITECT**
 - 1.5.3 This Contractor shall notify Local or State Environmental Agencies prior to the removal of any underground storage tanks and their related piping.
 - 1.5.3.1 This Contractor shall remove all related items as required by environmental authorities, and shall test surrounding soils as required.

- 1.5.4 All clearing and removal operations shall be performed in a manner such as to prevent any wash-off of soils from the site into streams and/or storm drainage systems. Appropriate sedimentation ponds, dikes, silt fences, collars, and filter media shall be employed to insure compliance with these requirements. Where a specific statute governs these procedures, such statute shall be complied with in its entirety. Such soil prevention, wash-off of soil to any existing, new storm drainage system(s), ponds, dikes, to offsite drainage shall be in conformance to Section 015723 -Storm Water Pollution Plan Control.

1.6 DRAINAGE MAINTENANCE:

- 1.6.1 During the entire course of clearing and removal operations, all existing drainage ways, both into and from the project area shall be rerouted as required and/or maintained in a functional condition and in accordance to Section 015723 and as directed by the ARCHITECT.
- 1.6.2 At all times during the clearing and removal operations, the exposed areas of subgrade shall be maintained in a condition compatible with positive drainage of the work area. Failure to maintain such drainage shall be considered adequate cause for the District Representative to order temporary suspension of the work.
- 1.6.3 If it should become necessary to stop work for indefinite periods, take every precaution to prevent damage or deterioration of the work already performed. Provide suitable and functional drainage by installing ditches, filter drains, temporary cut-off lines, etc., and erect temporary protective structures where necessary. All embankments shall be back bladed and suitably sealed to protect against adverse weather conditions.

PART 2 – PRODUCTS:

2.1 PROTECTION:

- 2.1.1 It shall be the Contractor's full responsibility to furnish and maintain all temporary barricades, warning lights, and other types of protection and prevent accidental injury to the general public and all personnel on the project.
- 2.1.2 All existing improvements and all existing active utility lines to remain (whether above or below ground) within the new construction area shall be properly and adequately protected from damage during the entire construction period. It shall be the responsibility of the Contractor to restore to their original condition any of these existing items that are damaged or disturbed in any way.
- 2.1.3 Protect all existing structures, utilities, and landscaping indicated to remain on the drawings.
- 2.1.3.1 All trees, shrubs, and other items, indicated to remain shall be protected during the entire progress of the work. This includes protection of the root system. The trees shall be fenced if they are located in or near an area being used for material storage or subject to damage by traffic during construction. Low hanging branches and unsound or unsightly branches on trees or shrubs designated to remain shall be removed. All trimmings shall be done by skilled workmen and in accordance with good tree surgery practices.

- 2.1.4 Any damage done or caused by any prime or sub-Contractor to existing structures, pipe lines, utilities, landscaping, etc., indicated to remain shall be repaired by him and at his expense in a manner acceptable to the Owner of the damaged property. Any prime or sub-Contractor shall report any existing damage prior to the beginning of their work.
- 2.1.5 All temporary shoring, bracing, etc., and maintenance there to required for the completion of clearing and removal work shall be provided by the Contractor whose work requires protection.
 - 2.1.5.1 This Contractor shall work in concert per local and state codes to insure the provision of adequate bracing, shoring, temporary cross over for pedestrian and vehicular traffic, including guard rails, lamps, warning signs and flags as required by agencies having jurisdiction as directed by the Owner. Remove same when necessity for protection ceases.
 - 2.1.5.2 The Contractor shall work in concert with the adjacent developer(s) to insure any additional provisions are implemented to insure safety and coordination of all offsite work.

2.2 MATERIALS:

- 2.2.1 All materials used to backfill excavations, trenches, holes, pits, etc., caused by utility, underground structure or underground storage tank removal shall meet the requirements for fill material and compaction indicated in Sections 312200, 312219, and 321216.

PART 3 – EXECUTION:

3.1 EXAMINATION:

- 3.1.1 Visit the site and offsite areas so that a full understanding of the difficulties and restrictions attending complete clearing of the site and removal of underground tanks and utilities is obtained. Verify the location of all pertinent items.
- 3.1.2 Verify with sewer department, water department, gas company, electric company, etc., that all existing utilities, services, and overhead lines have deactivated and abandoned prior to beginning removal work. Notify affected utility department or company prior to beginning removal work.

3.2 PREPARATION:

- 3.2.1 Cut drainage swales and provide temporary grading to carry storm water away from clearing area. No storm water will be permitted to stand in open excavations.
- 3.2.2 Provide, erect, and maintain temporary barriers and security devices as required. Protect all existing landscaping, structures, utilities, and site elements that are not to be demolished.
- 3.2.3 Notify all affected utility companies and local authorities and agencies prior to beginning the work.
- 3.2.4 Identify and tag all existing trees and other landscaping designated to remain.

3.2.5 Identify and locate a permanent stockpile area for topsoil. Verify with District Representative and see plans and/or Landscape Architect's plans for fill soil stockpile area. Coordinate with Landscape Contractor.

3.2.6 Identify and locate a waste area for temporary storage of removed materials and a permanent topsoil stockpile area. Stockpile area shall be approved by the ARCHITECT and/or Landscape Architect.

3.2.6.1 No materials may be buried or burned on the site as a means of disposal.

3.3 GRUBBING AND CLEARING:

3.3.1 From the entire site and area of work, remove all trees, rocks, boulders, and vegetation to ground level where the new building and all site work are to be located, regardless if shown or not shown on the drawings.

3.3.2 Scarify ground to remove debris, boulders, rocks, vegetation, and roots to 12 inches below grade, and remove all deep root systems, stumps, root-balls, and any major root systems.

3.3.3 Remove and legally dispose of debris. When and as directed by the Architect and/or Landscape Architect, stockpile selected stripped soil materials and rocks/boulders for subsequent use in landscaping work.

3.3.4 No less frequently than continuously each day, treat exposed ground areas for dust control. At windy conditions as deemed necessary by the Inspector and Construction Manager, provide dust control to suit the Inspector and ARCHITECTS's satisfaction.

3.4 OFFSITE WORK:

3.4.1 Clean haul roads on and off site to a distance of three miles from the site or as directed by the Architect, Resident Inspector, ARCHITECTS and/or per local ordinance.

3.4.2 "Clean" herein refers to properly remove dirt clods, flocks, tree branches, and other items which may fall off the hauling equipment or be "tracked" off the site.

3.4.3 Notify all affected utility companies and local authorities and agencies prior to beginning the work.

3.4.4 Identify and tag all existing trees and other landscaping designated to remain.

3.4.5 Identify and locate a permanent stockpile area for topsoil. Verify with District Representative and see plans for fill soil stockpile area. Coordinate with Landscape Contractor.

3.4.5.1 **No materials may be buried or burned on the site as a means of disposal.**

3.5 PERFORMANCE:

3.5.1 This Contractor shall be responsible for all clearing, grubbing, removing and disposing of trash and debris and for clearing and stockpiling all topsoil which are within the designated limits of the property, easements and roadway, unless otherwise indicated on the Drawings.

- 3.5.2 Prior to rough grading, storage of construction materials or the installation of any temporary construction facilities, strip areas per plans to be occupied by site improvements.
 - 3.5.2.1 Stockpile soil in previously designated areas or as directed by the District Representative. Sticks, stones, roots, weeds, grass, clods and rubbish shall be removed from the topsoil prior to stockpiling. If excess soil exists, it shall be disposed off-site.
 - 3.5.2.2 Only soil meeting the requirements of Section 329000 – Landscape Grading shall be stockpiled. All non-conforming soil shall be removed from the site.
 - 3.5.2.3 No topsoil may be used as structural fill under any building or paved areas.
- 3.5.3 This Contractor shall be responsible for removal of sidewalks, pavements, curbs, curbs and gutters, foundations, exterior slabs and sidewalks indicated to be removed on plans except for work covered under Landscape scope of work.
- 3.5.4 This Contractor shall be responsible for removal of all underground utilities, underground structures, etc., according to plans.
- 3.5.5 Protect any existing structures, utilities and all appurtenances to remain. Prevent movement or settling. Provide bracing and shoring as required.
- 3.5.6 Cease cleaning and removal operations immediately if any existing structure or utility appears in danger. Notify the District Representative and Civil Engineer of Record. Do not resume operations until directed.
- 3.5.7 All broken construction material, trash, and debris, tree slash, sidewalks, curbs, etc., will be considered “waste” and shall be removed from the site. “Waste” material shall be removed from the site as soon as possible and shall not be allowed to accumulate. Short-term storage of removed material shall be restricted to previously designated “waste” areas or as directed by the District Representative.
 - 3.5.7.1 No burning or burying of “waste” material will be permitted.
- 3.5.8 Continuously dampen all clearing and removal areas to prevent dust from rising during the operation. Provide hoses and/or water trucks as required.
- 3.6 FIELD QUALITY CONTROL:
 - 3.6.1 This Contractor shall retain an independent inspection firm or contact local officials and inspectors at locations where local building codes require special inspections.
- 3.7 CLEAN UP:
 - 3.7.1 Material designated for removal shall become the property of this Contractor, and any salvage value there from will accrue to this Contractor.
 - 3.7.2 Remove from the site and make legal disposition of all waste and debris. No waste or debris shall be burned or buried on the site as a means of disposal.

END OF SECTION

SECTION 31 22 19 – FINISH GRADING

PART 1 - GENERAL

All applicable portions of Division 1, including the drawings and general provisions of the contract, the general and supplementary conditions and Division 1 specification sections which apply to work of this section as if printed herein.

1.1 SUMMARY

- 1.1.1 Provide materials, labor and equipment necessary for the completion of finish grading as indicated on the Drawings and specified herein.
- 1.1.2 Related Sections:
 - 1.1.2.1 Section 312200 - Earthwork.
 - 1.1.2.2 Section 312300 - Excavation and Backfill for Utilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- 2.1.1 Refer to Section 312200 – Earthwork, for material for fill and planting areas.

PART 3 - EXECUTION

3.1 PREPARATION FOR FINISH GRADING

- 3.1.1 The entire area within the limits of grading as indicated on the Drawings shall be considered to the lines, grades, elevations, slopes, and cross sections indicated on the Drawings. When the grading has been completed, the areas shall be rolled smooth with a steel tandem roller or equal.

Should low spots develop during the rolling operation, such spots shall be filled and re-rolled smooth. Slopes, banks, and drainage depressions shall present a neat, uniform appearance on completion of the Work.
- 3.1.2 Fine grade to bring areas to required lines and grades. The subgrade elevation within the building area for slabs on grade (without a base course) shall be within 0.05 inch along a 10 foot straight edge.
- 3.1.3 Slope finish grades to drain surface water away from buildings, walks, paving, and other structures. Generally, grade with uniform slope between points where elevations are given, or between such points and existing grades. Excavate and grade swales to provide drainage away from and around buildings.
- 3.1.4 Areas to Receive Paving or Surfacing: Review plans and details for each area. See plans for paving and base course thickness. Review Drawings for sitework details.

- 3.1.5 Areas to Receive Topsoil and/or Planting: Where not otherwise indicated, areas outside of building shall be given uniform slopes between points for which finish grades are shown, or between such points and existing established grade, except that vertical curves or roundings shall be provided at abrupt changes in slope.
- 3.1.6 Rocks or cobbles larger than 1 inch in diameter shall not be placed in the upper 12 inches of planting area fill, and rocks or cobbles larger than 3/4 inch shall not appear on the finish graded surface. Structural fill and asphalt or concrete unless otherwise specified within the soils reports.
- 3.1.7 Surplus or Imported Material:
 - 3.1.7.1 Surplus material not needed for filling shall be removed from the site in a legal manner.
 - 3.1.7.2 Provide additional earth material as required. Imported material shall be tested and imported from an approved source at no additional cost to Owner. Approved by the Architect and/or Owner.
 - 3.1.7.3 All earth products to the site shall meet or exceed E.P.A. and State of California regulations for clean fill. Proof of compliance is the responsibility of the Contractor.
- 3.1.8 Preparation for Fills:
 - 3.1.8.1 Prior to placing fills, the existing surface shall be scarified and recompactd to at least 90 percent dry density per the ASTM D-1557 procedure.
- 3.2 FIELD QUALITY CONTROL
 - 3.2.1 Compaction of soils performed on this project shall be in accordance with section 312200 – Earthwork.

END OF SECTION

SECTION 31 23 00 – EXCAVATION AND BACKFILL FOR UTILITIES

PART 1 - GENERAL

All applicable portions of Division 1, including the drawings and general provisions of the contract, the general and supplementary conditions and Division 1 specification sections which apply to work of this section as if printed herein.

1.1 SUMMARY

- 1.1.1 Section includes: Excavation and backfill for utilities and storm drains as indicated on the Drawings and specified herein.

1.2 REFERENCE STANDARDS

- 1.2.1 2019 CBC (CCR Title 24, Part 2), Chapter 18A.
- 1.2.2 CAL-OSHA requirements.

1.3 PERFORMANCE REQUIREMENTS

- 1.3.1 Be fully responsible to furnish and maintain temporary barricades, warning lights, and other types of protection and to prevent accidental injury to the general public and personnel employed on the project.
- 1.3.2 Provide adequate cribbing, sheating, and shoring as necessary to safely retain the earth sides of excavation and trenches from caving and other damage resulting from excavating and trenches from caving and other damage resulting from excavating, together with suitable forms of protection against property damage and bodily injury to personnel employed on the work and the general public. The Contractor shall be responsible for the design, for installation, and maintenance of required cribbing and shoring.
- 1.3.3 Protect new and existing utilities from damage during the course of installation, and repair work so damaged at no additional cost to the Owner.

1.4 PERMITS

- 1.4.1 Obtain permits, fees, or bonds required for the work performed under this section. Owner will pay the cost for permanent construction permits. Bonds and encroachment permits shall be paid by the Contractor.

1.5 TESTING AND INSPECTION

- 1.5.1 Contractor shall be responsible for notifying the Testing Laboratory in advance, so that he/she may be present to perform his services as needed.
- 1.5.2 The Testing Laboratory shall submit compaction reports to the Architect, and shall notify the Architect immediately of test failures.

1.6 QUALITY ASSURANCE

1.6.1 Bedding Material:

1.6.1.1 Bedding sand shall be Class A, screened fill sand, with a maximum particle size of ¼ inch, and shall be free of expansive material and organic matter. Material shall have a sand equivalent of not less than 30 per ASTM D2419.

1.6.1.2 Bedding crushed rock shall be clean crushed stone free of organic matter and shall conform to the following gradation:

<u>US Standard Sieve Size</u>	<u>Percent Passing by Weight</u>
25mm (1")	100
19mm (3/4")	90-100
12.5mm (1/2")	30-60
9.5mm (3/8")	0-20
4.75mm (No. 4)	0-5
2.36mm (No.8)	---

1.6.1.3 Bedding material for utility lines and storm drains outside the property lines shall be as required by the agency having jurisdiction.

1.6.2 Backfill material for storm drain and utility lines shall be non-expansive granular material, such as clean sand, and shall be placed in a minimum thickness of 6 inches for bedding and backfilled to 12 inches above the top of pipe.

1.6.3 Additional earth material required to complete the work shall be provided by the Contractor at his expense.

1.6.4 All earth products to the site shall meet or exceed United States Environmental Protection Agency (US EPA) and State of California Regulations for clean fill. Proof of compliance is the responsibility of the Contractor.

1.6.5 Imported earth shall be of granular nature with sufficient binder to form a firm, stable, unyielding subgrade. Adobe or clay soils will not be acceptable. Earth imported shall be relatively non-expansive with an expansion index of less than 35, be clean and free from rubbish and debris and rock larger than 3 inches in maximum dimensions, not have sulfate content greater than 1,000 parts per million. Imported fill material shall have an electrical resistivity box procedure shown in ASTM G57. Imported material to be used in areas to receive planting shall be of such quality as to support plant life.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION

3.1 PREPARATION

3.1.1 Underground Utilities: Carefully lay out the route of each underground utility prior to trenching. Coordinate the work of various trades to avoid conflicts.

3.1.2 Clearances: Maintain required horizontal and vertical clearances from structural footings for utility trenches running parallel to footings, as detailed on Structural Drawings. In the event of conflict, the Architect shall be notified.

3.2 TRENCHING

3.2.1 Excavate trenches for utilities to the required lines, trades and elevations indicated on the drawings and as specified. Hand trim changes in direction and bottoms of trenches. Accurately shape and thoroughly compact trench bottom to required grade. Keep trenches clean until installed work has been approved.

3.2.2 Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.

3.2.2.1 Clearance: 8 inches on each side of pipe or conduit.

3.2.3 Trench Bottoms: Excavate trenches 6 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

3.4 BEDDING

3.4.1 Place and compact 6 inch bedding course on trench bottoms. Shape bedding course to provide continuous support for bells, joints and barrels of pipes and for joints, fittings, and bodies of conduits.

3.4.1.1 Provide crushed rock bedding for sanitary and storm sewer piping.

3.4.1.2 Provide sand bedding for water and fire line piping.

3.4.2 Place and compact initial backfill of bedding, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system. This area shall be mechanically compacted to achieve 90% relative compaction per ASTM D-1557.

3.4.3 Utility trenches located within the zone of structural footing influence require special backfill consisting of 2-sack sand/cement slurry. The zone of influence to a distance of 10 feet beyond footings is the zone below a 2(H):1(V) downward plane starting 9 inches above the bottom outer edge of the structural footing.

3.4.4 Backfill with approved native or import soils as specified in 312200 Earthwork.

3.4.5 Spread, water, and mix backfill to obtain optimum moisture content. Compact by mechanical means in 6 inch lifts to a minimum relative density of 90 percent in accordance with ASTM D-1557.

3.4.6 Continue backfilling as required to secure final grade elevations.

3.4.7 Backfill existing utilities which may be uncovered during course of construction in the same manner as specified herein for new utilities.

3.4.8 Coordinate backfilling with Representative of Owner's Testing Laboratory.

3.5 CLEANUP

3.5.1 Transport unsuitable material to a legal off-site disposal area.

END OF SECTION

SECTION 32 12 16 – ASPHALTIC CONCRETE PAVING

PART 1 - GENERAL

All applicable portions of Division 1, including the drawings and general provisions of the contract, the general and supplementary conditions and Division 1 specification sections which apply to work of this section as if printed herein.

1.1 WORK INCLUDED:

- 1.1.1 Work includes asphaltic concrete paving over aggregate base.

1.2 RELATED WORK:

1.2.1 Related Work Specified Elsewhere:

- 1.2.1.1 Section 311000 - Site Clearing: Removal of existing asphaltic concrete paving.
- 1.2.1.2 Section 312200 - Earthwork: Preparation and compaction of subgrade.

1.3 QUALITY ASSURANCE:

- 1.3.1 Qualifications of Asphalt Concrete Producer: Bulk asphaltic concrete producer regularly engaged in production of hot-mix, hot-laid asphalt concrete.

1.3.2 Regulatory Requirements:

- 1.3.2.1 In addition to complying with the applicable codes and regulations of governmental agencies having jurisdiction, comply with the applicable requirements of CALTRANS Standard Specifications for Public Works Construction.
- 1.3.2.2 Where the provisions of applicable codes, regulations and standards conflict with the requirements of this specifications, comply with the more stringent provisions.

1.3.3 Source Quality Control:

- 1.3.3.1 Tests: Materials for which physical characteristics have been stipulated shall have had such characteristics independently confirmed by laboratory tests employing industry-recognized procedures. Both the laboratory performing the tests and the test methods employed will be subject to the approval of the Architect.

- 1.3.3.2 Certification: Furnish certification, in written form, from the asphaltic concrete producer, confirming the conformance of the following with the requirements of this specification:

- 1.3.3.2.1 Materials proposed for incorporation into the Work.
- 1.3.3.2.2 Asphaltic concrete mix design formulae.

1.4 SUBMITTALS:

1.4.1 Product Data: For proprietary products, submit complete manufacturer's description literature and specifications in accordance with the provisions of Section 013300.

1.4.1.1 Materials List: Submit complete lists of materials proposed for use, giving the manufacturer's name, catalog number, and catalog cut for each item where applicable.

1.4.1.2 Manufacturer's Recommendations: Submit the manufacturer's current recommended methods of installation, including relevant limitations, safety and environmental cautions, and application rates.

1.4.2 Test Reports: When and as directed by the Architect and/or Owner, submit certified laboratory test reports confirming physical characteristics of materials used in the performance of the Work of this Section.

1.4.3 Mixes: Submit asphaltic concrete mix design formulae.

1.5 PROJECT CONDITIONS:

1.5.1 Weather Limitations:

1.5.1.1 Apply bituminous prime and tack coats only when the ambient temperature in the shade is above 50 degrees F.

1.5.1.2 Do not apply when the base surface is wet or contains an excess of moisture which would prevent uniform distribution and the required penetration.

1.5.1.3 Construct asphalt concrete surface course only when atmospheric temperature is above 40 degrees F, when the underlying base is dry, and when weather is not rainy.

1.5.2 Grade Control: Establish and maintain the required lines and grades, including crown and cross-slope, for each course during construction operations.

1.5.3 Traffic Control: Maintain vehicular and pedestrian traffic during paving operations, as required for other construction activities.

PART 2 - PRODUCTS

2.1 AGGREGATES: Use materials and gradations that have performed satisfactorily in previous installations.

2.1.1 Base Course Aggregate: Class 2 Aggregate Base mineral aggregate, 3/4 inch maximum size, as specified in CALTRANS Standard Specifications

2.1.1.1 Recycled asphalt paving may be used as base course aggregate, subject to complying with CALTRANS Standard Specifications.

2.1.2 Asphalt Aggregate: Type B Aggregate, as specified in CALTRANS Standard Specifications.

2.1.2.1 3/4 inch maximum size for base course.

2.1.2.2 1/2 inch maximum size for surface course.

2.2 ASPHALT MATERIALS

2.2.1 Asphalt Cement: Steam Refined, penetration-graded material. PG 64-10 conforming to CALTRANS Standard Specifications.

2.2.2 Prime Coat: Asphalt prime coat conforming to CALTRANS Standard Specifications.

2.2.3 Tack Coat: Asphalt tack coat conforming to CALTRANS Standard Specifications.

2.2.4 Seal Coat: Emulsified asphalt with a minimum 2 percent – 3 percent latex or copolymer added with 2-4 lbs of grade No. 30 silica sand added per gallon and mechanically agitated.

2.3 ASPHALT MIXES

2.3.1 Hot-Mix Asphalt: Provide dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and designed according to procedures in AI's "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types."

2.3.1.1 Comply with CALTRANS Standard Specifications.

2.3.1.2 Provide mixes complying with the composition, grading, and tolerance requirements of ASTM D 3515 for the following nominal, maximum aggregate sizes:

2.3.1.2.1 Surface Course: 1/2 inch maximum.

2.3.1.2.2 Base Course: 3/4 inch maximum

2.4 CRACK SEALER

2.4.1 Rubberized joint sealant complying with Federal Standards ASTM D5329 Parking Lot Crack Sealer.

2.5 PAVEMENT MARKING PAINT:

2.5.1 Latex, water-base emulsion, ready-mixed, complying with FS TT-P-1952.

2.5.2 Color: As indicated.

2.6 ASPHALT-AGGREGATE MIXTURES:

2.6.1 Job-mix Criteria:

2.6.1.1 Provide job-mix formulas for each required asphalt-aggregate mixture.

2.6.1.2 Establish a single percentage of aggregate passing each required sieve size, a single percentage of asphalt cement to be added to aggregate, and a single temperature at which asphalt concrete is to be produced.

2.6.1.3 Comply with the mix requirements of Caltrans Standard Specifications.

2.6.1.4 Maintain material quantities within allowable tolerances of the governing standards.

2.7 HEADERS AND STAKES:

- 2.7.1 Provide 2 inches by 6 inches redwood header adjacent to asphalt paving as shown on plans. Redwood header shall be placed along the entire length where asphalt paving butts to all turf areas, planter areas, modular buildings or areas where concrete walkways do not occur.

2.8 HERBICIDE:

- 2.8.1 Provide a commercial chemical for weed control, registered by Environmental Protection Agency (EPA). Provide liquid, or wettable powder form.

PART 3 - EXECUTION

3.1 PREPARATION:

3.1.1 Aggregate Base Course:

- 3.1.1.1 Check subgrade for conformity with elevations and section immediately before placing aggregate base material.
- 3.1.1.2 Place aggregate base material in compacted layers not more than 4 inches thick. Compaction shall be obtained by use of an approved power roller weighing not less than 10 tons.
- 3.1.1.3 Spread, shape, and compact all aggregate base material deposited on the subgrade during the same day.
- 3.1.1.4 Compact aggregate base course material to not less than 95 percent of maximum density: ASTM D 1557, Method D.
- 3.1.1.5 Test density of compacted aggregate base course: ASTM D 2167.
- 3.1.1.6 Conduct one (1) test for each 2,500 square yards of in-place material, but in no case no less than one daily for each layer.
- 3.1.1.7 Treat all sub-base with weed killer in accordance with manufacturer's instructions. Take extreme precaution to confine weed poison to area covered with asphaltic concrete, and provide all necessary protection to prevent injury or damage to life or property.

3.1.2 Prime Coat:

3.1.2.1 Uniformly apply at rate of 0.20 to 0.25 gallons per square yard over compacted and cleaned sub-base surface.

3.1.2.2 Apply enough material to penetrate and seal, but not flood the surface.

3.1.2.3 Allow to cure and dry as long as required to attain penetration and evaporation of volatile, and in no case less than 24 hours unless otherwise acceptable to the Architect.

3.1.2.4 Blot excess asphalt with just enough sand to prevent pick-up under traffic. Remove loose sand before paving.

3.1.3 Tack Coat:

3.1.3.1 Dilute material with equal parts of water and apply to contact surfaces of previously constructed asphalt concrete or Portland cement concrete and similar surfaces.

3.1.3.2 Apply at rate of 0.05 to 0.15 gallons per square yard of surface.

3.1.3.3 Apply tack coat by brush to contact surfaces of curbs, gutters, manholes, and other structures projecting into or abutting asphalt concrete pavement.

3.1.3.4 Allow surfaces to dry until material is at condition of tackiness to receive pavement.

3.2 PREPARING THE MIXTURE:

3.2.1 Comply with ASTM D 995 for material storage, control, and mixing, and for plant equipment and operation.

3.2.2 Heating:

3.2.2.1 Heat the asphalt cement at the mixing plant to viscosity at which it can be uniformly distributed throughout mixture.

3.2.2.2 Use lowest possible temperature to suit temperature-viscosity characteristics of asphalt.

3.2.2.3 Do not exceed 350 degrees F.

3.2.3 Aggregate:

3.2.3.1 Deliver dry aggregate to mixer at recommended temperature to suit penetration grade and viscosity characteristics of asphalt cement, ambient temperature, and workability of mixture.

3.2.3.2 Accurately weigh or measure dry aggregates and weigh or meter asphalt cement to comply with job-mix formula requirements.

3.2.4 Joints:

3.2.4.1 Carefully make joints between old and new pavements, or between successive days' work, to ensure a continuous bond between adjoining work.

3.2.4.2 Clean contact surfaces free of sand, dirt, or other objectionable material and apply tack coat.

3.3 COMPACTING THE MIX:

3.3.1 Provide sufficient power rollers to obtain the required pavement density. Minimum 10 ton power roller.

3.3.2 Begin rolling operations as soon after placing when the mixture will bear weight of roller without excessive displacement.

3.3.3 Do not permit heavy equipment, including rollers to stand on finished surface before it has thoroughly cooled or set.

3.3.4 Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

3.3.5 Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of transverse and longitudinal joints and outside edge.

3.3.6 Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot and in condition for compaction. Continue second rolling until mixture has been thoroughly compacted.

3.3.7 Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained specified density.

3.3.8 Patching:

3.3.8.1 Remove and replace defective areas.

3.3.8.2 Cut-out and fill with fresh, hot asphalt concrete.

3.3.8.3 Compact by rolling to specified surface density and smoothness.

3.3.8.4 Remove deficient areas for full depth of course.

3.3.8.5 Cut sides perpendicular and parallel to direction of traffic with edges vertical.

3.3.8.6 Apply tack coat to exposed surfaces before placing new asphalt concrete mixture.

3.4 FIELD QUALITY CONTROL:

3.4.1 General: In addition to other specified conditions, comply with following minimum requirements:

- 3.4.1.1 Test in-place asphalt concrete courses for compliance with requirements for density, thickness and surface smoothness.
 - 3.4.1.2 Provide final surfaces of uniform texture, conforming to required grades and cross-sections.
- 3.4.2 Thickness: In-place compacted thicknesses shall conform to the dimensions shown on the Drawings. Variation from indicated thicknesses shall not exceed plus or minus 1/2 inch. If thickness is not shown, minimum thickness shall be 3 inches of asphalt paving over 6 inches of granular base and at bus drop-off areas and fire lanes, provide 4 inches of asphalt paving over 10 inches of granular base. Actual structural sections shall be determined after an "R" value test has been conducted by a qualified geotechnical engineer on the prepared sub-base material.
- 3.4.3 Surface Smoothness:
 - 3.4.3.1 Test finished surface of each asphalt concrete course for smoothness, using a 10-foot straightedge applied parallel to and at right angles to centerline of paved areas.
 - 3.4.3.2 Surfaces will not be acceptable if exceeding the following:
 - 3.4.3.2.1 Base Course: 1/4 inch in 10 feet.
 - 3.4.3.2.2 Surface Course: 3/16 inch in 10 feet.
- 3.4.4 Asphalt Concrete Intersection to Concrete Control:
 - 3.4.4.1 All asphalt concrete paved areas that butt to or intersect to all concrete, concrete gutters, concrete swales and concrete walkways, the asphalt concrete shall be a minimum 1/4 inch to maximum 1/2 inches above the adjacent concrete surface after applying finish rolling. In no case shall the asphalt concrete paving, after final rolling, at the intersection of any concrete surfaces, shall be below the finish concrete paved surface(s) unless specifically detailed on the drawings.
- 3.5 FLOOD TEST:
 - 3.5.1 Flood Test: Before applying a seal coat or striping, a water test shall be made in the presence of the Inspector of Record. The flooding shall be done by water tank truck. All depressions, where water ponds to a depth of more than 1/8 inch shall be filled or the slope shall be corrected to provide proper drainage. The edges of the fill shall be feathered and smoothed so that the joint between the fill and the original surface is invisible. All corrected work of the asphalt concrete paving shall be of the same mix design.
- 3.6 SEAL COAT:
 - 3.6.1 After completing the flood test and after receiving approvals from the Owner, all new A.C. pavements (minimum 30 calendar days after Owner approvals) shall receive "Laycold Walk Top" as manufactured by Chevron Asphalt Company. The sealer shall consist of suitable fibrated chemical type asphaltic base binders and fillers having a container consistency suitable for troweling after thorough stirring. It shall contain no clay or other deleterious substances.
 - 3.6.2 Place the entire contents of each drum sealer in a plaster or pug mill type mixer thoroughly. Where less than 50 gallons of sealer are used, mixing may be done in a

mortar box. During mixing, the sealer may be diluted with water to produce a uniform, free flowing consistency, but in no case shall it be diluted with more than one (1) part of water to four (4) parts of "walk top".

3.6.3 Areas to receive Walk-Top shall be swept clean and before application, lightly sprayed with water, leaving it cool and damp, but without free water.

3.6.4 Apply Walk Top by pouring from a can or a wheeled container in continuous parallel lines and spreading immediately with rubber-faced squeegees or with long-handled hair brooms. The squeegee or broom shall be pulled at an angle from the line of spread to continually roll the material toward the operator and not to overflow or spill over its forward edge away from the operator.

Each coat of sealer shall be thoroughly dry before the succeeding coat is applied.

3.6.5 Make two (2) or more applications using at least 35 gallons of sealer (before dilution) per 1,000 square feet of area.

3.6.6 The finished surface seal, when dry and thoroughly set, shall be smooth, tough, waterproof, resilient, of uniform black color and free from coarse textured areas, lap marks, ridges and other surface irregularities. **Should any defects appear in the finished surface, apply as many additional coats of sealer as may be required to produce the specified finished surface at no additional cost.** Protect from traffic during all operations and until the sealer is thoroughly set and cured and does not pick-up under foot or wheeled traffic.

3.7 ADJUSTING AND CLEANING:

3.7.1 Cleaning: After completion of paving operations, clean surfaces of excess or spilled asphalt materials or marking paint to the satisfaction of the Architect.

3.8 PROTECTION:

3.8.1 After final rolling, do not permit vehicular traffic on asphalt concrete pavement until it has cooled and hardened, and in no case sooner than 6 hours.

3.8.2 Provide barricades and warning devices as required to protect pavement and the general public.

END OF SECTION

SECTION 32 16 00 – CONCRETE PAVING, CURBS AND WALKS

PART 1 - GENERAL

All applicable portions of Division 1, including the drawings and general provisions of the contract, the general and supplementary conditions and Division 1 specification sections which apply to work of this section as if printed herein.

- 1.1 SECTION INCLUDES: Description of requirements for materials, fabrications and installation of Curbs, Gutters and Walks and accessory items as shown on drawings and necessary to complete the Concrete Work. Work to include but not be limited to the following:
 - 1.1.1 Examine all other sections for work related to those sections which are required to be included as work of this Section.
 - 1.1.2 Concrete curbs, gutters, walks and concrete pavements.
- 1.2 RELATED WORK IN OTHER SECTIONS:
 - 1.2.1 Section 321216 – Asphalt Concrete Paving.
 - 1.2.2 Section 033000 – Concrete Work, except as specified herein.
 - 1.2.3 Section 312200 – Earthwork.
- 1.3 SUBMITTALS: Refer to Section 013300 for procedures.
 - 1.3.1 Provide manufacturer's product data for all materials used and printed recommendations for installation.
 - 1.3.2 Submit all shop drawings as requested by Architect for review and approval, to verify conformance with applicable codes and agencies having jurisdiction.
- 1.4 QUALITY ASSURANCE:
 - 1.4.1 Regulatory Requirements: Comply with applicable portions of codes and regulations of governmental agencies having jurisdiction.
 - 1.4.2 Qualifications: Use skilled workers who are thoroughly trained and experienced and who are completely familiar with the specified requirements and methods to perform and complete the scope of work under Contract.
 - 1.4.3 Protection: Provide all necessary barricades or temporary fencing necessary to protect public and finished work from injury or damage until work is complete.

PART 2 – PRODUCTS AND EXECUTION:

- 2.1 MATERIAL AND WORKMANSHIP: Conform to the applicable sections of "Standard Specifications for Public Works Construction", latest Edition, and all errata and addenda thereto except where noted otherwise in this Section.

2.2 WORK PROCEDURES:

- 2.2.1 Pay for all city permits in connection with this work.
- 2.2.2 The local building department will inspect and approve all concrete work within the street right of ways.

2.3 COLOR AS APPROVED BY: Architect.

2.4 FINISH:

- 2.4.1 See Paragraph 3.11.2 for ramps and walk finish.
- 2.4.2 Gutters: Light broom finish with 3-inch wide steel trowel finish at flow lines.
- 2.4.3 Curbs: Steel trowel finish.
- 2.4.4 Stair treads and landings: Medium broom finish.
- 2.4.5 On-Site Drive Aprons: Heavy broom finish.
- 2.4.6 Curbs adjacent to accessible parking stalls shall be painted blue.
- 2.4.7 A 2-inch wide line shall be painted with 70 percent contrast epoxy paint, as selected by Architect, with grits adjacent to the nose of all stair treads and shall extend the entire width of each tread.

2.5 CRACKING:

- 2.5.1 Any portion of concrete pavement which develops cracks shall be removed to the nearest joint and replaced. Replaced portions shall match adjacent concrete in texture color and elevation.

2.6 EXPANSION JOINT FILLER:

- 2.6.1 Premolded Joint Filler: Premolded joint filler shall consist of premolded strips of a durable resilient material, and shall be one of the following:
 - 2.6.1.1 Preformed Expansion Joint Filler (Bituminous) ASTM D 994
 - 2.6.1.2 Nonextruding and Resilient Filler (Bituminous) ASTM D 1751
 - 2.6.1.3 Nonextruding and Resilient Filler (Non-bituminous) ASTM D 1752

PART 3 – EXECUTION:

3.1 PREPARATION:

- 3.1.1 Base Course: Sub-grade shall be prepared in accordance with Section 312200 Earthwork.

3.2 INSTALLATION:

- 3.2.1 Formwork:

- 3.2.1.1 Stake rigidly at 4 feet on centers and secure against displacement. Formwork shall not deviate more than 1/2-inch from required vertical positions and 1 inch from required horizontal positions.
- 3.2.1.2 Carefully set forms to alignment, grade, and required dimensions. Hold forms rigidly in place by stakes, clamps, spreaders, and braces where required to insure rigidity.
- 3.2.1.3 Apply form release to form lumber in accordance with manufacturer's recommendations.
- 3.2.1.4 Place joint filler on vertical surfaces in contact with concrete paving.
- 3.2.2 REINFORCEMENT: Upon completion of base course and formwork, install reinforcement where shown on the Contract Drawings.
 - 3.2.2.1 Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.
 - 3.2.2.2 Position, support, and secure reinforcement against displacement by concrete placement operations.
 - 3.2.2.3 Place reinforcement to obtain the required coverage for concrete protection.
 - 3.2.2.4 All slabs and concrete walkways shall conform to the guidelines and recommendations of the American Concrete Institute for reinforcement of cast-in-place concrete slabs. Care shall be taken to place the reinforcement mid-height in the slab.
- 3.3 QUALITY ASSURANCE:
 - 3.3.1 All work shall be installed by a Licensed Contractor who shall provide a foreman or supervisor who has experience with and knowledge of concrete processes.

The Contractor shall provide a jobsite surface finish sample (100 square feet or 9.3 square meters minimum) to be approved by the Architect prior to the start of the construction. Said sample shall be the standard for the balance of the work installed, and shall be protected against damage until final approval from the Architect. The cost for the construction and protection of the referee sample shall be borne by the Contractor and shall be part of the Contractor's bid.
- 3.4 CONCRETE MIX DESIGN:
 - 3.4.1 For new construction, concrete shall have a minimum compressive strength as follows:
 - 3.4.1.1 Concrete curbs, gutters, sidewalks, and driveway aprons: 2500 psi, concrete type 520-C-2500 in accordance with latest "Greenbook" specifications
 - 3.4.1.2 Concrete cross gutters, ribbon or valley gutters, trash enclosure slabs, and any pavement not otherwise specified: 3250 psi, concrete type 560-C-3250 in accordance with latest "Greenbook" specifications
 - 3.4.1.3 Storm drain catch basins and manholes: 3250 psi, concrete type 560-C-3250 in accordance with latest "Greenbook" specifications

- 3.4.2 Portland cement shall conform to ASTM C150 Type II. Aggregates shall conform to ASTM C33. Mixing water shall be fresh, clean and potable. No admixtures containing calcium chloride shall be permitted.

3.5 OFF-SITE CONCRETE WORK

- 3.5.1 Concrete driveway aprons, street sidewalks, curbs, gutters, etc., indicated to be constructed outside of property lines shall conform to the standards and specifications of the public agency having jurisdiction and shall be subject to inspection by their representative. Obtain and pay for necessary permits. The Owner will pay for inspection fees.

3.6 CURING FOR NEW CONSTRUCTION:

- 3.6.1 All slabs shall be cured properly using conventional five (5) day water cures or using membrane-forming curing agents.

3.7 INSTALLATION PROCEDURES:

- 3.7.1 For new construction, concrete shall be installed in accordance with the standards and specifications of the American Concrete Institute (ACI).
 - 3.7.1.1 Concrete shall be tested in accordance with ASTM F1869-98 and/or ASTM E1970-97.
 - 3.7.1.2 Concrete shall have a pH level between 7-9.
 - 3.7.1.3 Construction joints shall be transferred through the finished surface by tooling them into the finished surface. Construction joints may be filled using a semi-rigid elastomeric material in accordance with manufacturer's recommendations.

3.8 PROTECTION AND MAINTENANCE:

- 3.8.1 Newly completed surfaces shall be protected.

3.9 APPLICATION:

3.9.1 Concrete:

- 3.9.1.1 Mixing: Transit mix the concrete in accordance with provisions of ASTM C94.
- 3.9.1.2 Conveying and Placing: Place concrete in accordance with pertinent recommendations contained in ACI 304 and with the following:
 - 3.9.1.2.1 Deposit concrete continuously in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or places of weakness within the section.
 - 3.9.1.2.2 Deposit and consolidate concrete in a continuous operation within the limits of construction joints until the placing of a panel or section is completed.
 - 3.9.1.2.2.1 Bring surfaces to the correct level with a straight-edge, and then strike off.

3.9.1.2.2.2 Use bullfloats or derbies to smooth the surface, leaving it free from bumps and hollows.

3.9.1.2.3 Do not sprinkle water on the plastic surface. Do not disturb the surfaces prior to start of finishing operations.

3.9.1.2.4 Do not use concrete which has become non-plastic and unworkable, which does not meet required quality control limits, or which has been contaminated by foreign materials.

3.10 CONTROL JOINTS / WEAKENED PLANE JOINTS:

3.10.1 Tops of joints shall be installed flush with the concrete surface. Depth of joint shall be a minimum of 1/4 the thickness of slab. Use control joints/weakened plane joints on curbs, curbs and gutters, ribbon or valley gutters, and cross gutters at maximum intervals of 10 feet on center. Sawed joints may be used in lieu of the above upon Architect's written approval providing they are at least 1-1/2 inch deep.

3.11 FINISHES:

3.11.1 Paved areas between buildings will consist of various different finishes such as medium and heavy broom, steel trowel exposed aggregate and rock salt. See architectural drawings for specific type of finish for these areas including colored concrete.

3.11.2 Walks, Pavements, Ramps: Unless otherwise noted, medium broom finish perpendicular to longitudinal direction of walks, and at exterior ramps heavy broom finish.

3.11.2.1 Slopes Less Than 6 percent: Surfaces with a slope of less than 6 percent gradient shall be at least as slip-resistant as that described for medium broom finish, perpendicular to the direction of travel.

3.11.2.2 Slopes 6 percent or Greater: Surfaces with a slope of 6 percent gradient or greater shall be slip-resistant, equivalent to a heavy broom finish.

3.11.3 Gutters: Light broom finish with 3 inch wide steel trowel finish at flowlines.

3.11.4 Concrete mow strips or headers: Medium broom finish.

3.11.5 Portland cement concrete paving shall be stable, firm, and slip resistant and shall comply with CBC Sections 11B-302 and 11B-403.

3.12 CURING:

3.12.1 Comply with California Building Code, Title 24, Section 1903A.11, Part 2.

3.12.1.1 Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least seven (7) days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

3.12.2 Curing Methods: Perform curing of concrete by curing as herein specified.

3.12.2.1 Provide moisture-curing by the following methods:

- 3.12.2.1.1 Keep concrete surface continuously wet by covering with water.
- 3.12.2.1.2 Continuous water-fog spray.
- 3.12.2.1.3 Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4 inch lap over adjacent absorptive covers.
- 3.12.2.2 Provide curing and sealing compound to exposed exterior slabs, walks, and curbs, as follows:
 - 3.12.2.2.1 Applied specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Re-coat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - 3.12.2.2.2 Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid, floor hardener, waterproofing, damp-proofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting, and other coatings and finish materials, unless otherwise acceptable to Architect.
 - 3.12.2.2.3 Concrete slabs and paving shall be properly cured and protected against damage and defacement of nature during construction operations. If weather is hot or surface has dried out, spray surface with fine mist of water starting not later than 2 hours after final troweling. Surface of finish shall be kept continuously wet for at least 10 days. Wetting is considered emergency work and shall be performed on weekends and holidays, if necessary.
- 3.12.3 In lieu of water curing, within 24 hours after finishing, the concrete may be cured with a clear liquid curing compound such as "Sealtight No. 1100 Clear" by W.R. Meadows or equal applied in accordance with manufacturer's recommendations.
- 3.13 FIELD QUALITY CONTROL:
 - 3.13.1 Flood Tests: Concrete gutters and concrete pavement shall be given a flood test in the presence of the Inspector. Concrete work where water ponds and does not run off in a reasonable amount of time, shall be removed to the nearest score or joint line and replaced to provide proper drainage. Use a water hose to flood test concrete areas. If water stands 1/8 inches in height or more, then remove the section of concrete from concrete joint to concrete joint.

END OF SECTION

SECTION 32 31 13 – CHAINLINK FENCES AND GATES

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. Fence framework, fabric, and accessories
 - 2. Excavation for post bases.
 - 3. Concrete anchorage for posts and center drops for gates.
 - 4. Swing gates, signs and related hardware.
 - a. Manual
- B. Related Requirements:
 - 1. Section 08 71 00, Door Hardware
 - 2. Section 32 16 00, Sitework Concrete.

1.3 REFERENCE STANDARDS

- A. Conform to current adopted reference standards by date of issue of the current code cycle and the date of the Contract Documents.
- B. ASTM International
 - 1. ASTM A 392 - Zinc-Coated Steel Chain-Link Fence Fabric
 - 2. ASTM A 824 - Metallic-Coated Steel Marcellled Tension Wire for Use with Chain Link Fence
 - 3. ASTM B221/B221M Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 4. ASTM F 552 - Terminology Relating to Chain Link Fencing
 - 5. ASTM F 567 - Installation of Chain-Link Fence
 - 6. ASTM F 626 - Fence Fittings
 - 7. ASTM F 900 - Industrial and Commercial Swing Gates
 - 8. ASTM F 1043 - Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework
 - 9. ASTM F 1083 - Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
 - 10. ASTM F 1184 - Industrial and Commercial Horizontal Slide Gates
 - 11. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- C. SSPWC - Standard Specifications for Public Works Construction, Latest Edition

- D. CLFM - Chain Link Fence Manufacturer's Institute
- E. CBC - 2019 California Building Code
 - 1. Chapter 10, Means of Egress
 - 2. Chapter 11B, Accessibility to Public Buildings, Public Accommodations, Commercial Buildings and Public Housing.
 - 3. Chapter 19A, Concrete
- F. National Ornamental and Miscellaneous Metals Association (NOMMA)
 - 1. NOMMA Guidelines - Guideline 1 Joint Finishes

1.4 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in commercial quality chain link fencing with five years' experience.

1.5 ACTION SUBMITTALS

- A. Shop drawings including plan layout, grid, spacing of components, accessories, fittings, hardware, footings, anchorages and schedule of components.
- B. Product data.
- C. Manufacturer's installation instructions.
- D. Three samples illustrating each fence fabric finish.

1.6 WARRANTY

- A. Provide two-year warranty to insure materials against rusting or breakdown of finish. Provide adjustments as needed to assure continued smooth operation of gates.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Acceptable Manufacturers
 - 1. Master-Halco/Anchor Fence Inc., Baltimore, MD
 - 2. Boundary Fence and Railing Co., Richmond, NY.
 - 3. Reeves Southeastern Wire Corp., Tampa, FL.
 - 4. Ameristar Fence Products, Tulsa, OK.
 - 5. Or equal in accordance with Division 01, General Requirements for substitutions.
- B. Framework: ASTM F1043; Type I Group IA. ASTM F1083; Schedule 40, Intermediate Strength Grade 50,000 psi, hot-dipped galvanized steel pipe, minimum 1.8 oz/sq.ft., Sized in accordance with Table 206-6.2, Standard Specifications for Public Works Construction. One piece without joints in accordance with CLFM I.

CHAINLINK FENCES AND GATES

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1. EXIT Gates: galvanized square tube, ASTM A500, Grade B, for square pipe at lintels and gate posts, minimum galvanizing coating of 1.8 ounces per sq. ft. 2-1/2 inches square.
- C. Fabric: Type II ASTM A817, Class 2 ASTM A392, Class 2 (not less than 2 oz/ft sq.), galvanized before (G.B.W.) weaving, 2-inch mesh, 9 gauge, interwoven, top and bottom knuckled selvage. Single width fabric.

2.2 CONCRETE MIX

- A. Concrete: Normal Portland cement; 3,000 psi at 28 days; 4-inch slump, conforming to ACI 318-11 Section 5.2, CBC Section 1905A and Section 32 13 13 Sitework Concrete.
 1. Design Mix: Conform to Section 1905A.1 CBC.
 2. Reinforcement: per Section 32 13 13 as indicated on drawings.

2.3 COMPONENTS

- A. Nominal pipe size (NPS) and weight (Class 1) in pounds per lineal foot, ASTM F1083; Schedule 40 Intermediate Strength Grade 50,000 psi, hot-dipped galvanized steel pipe, minimum 1.8 oz/sq.ft.

	NPS	Pounds/LF	Outside Diameter Min. (OD)
1.	1-1/4:	2.27	1.66"
2.	1-1/2:	2.72	1.90"
3.	2:	3.65 (3.87 for sq. pipe at exit gate frames)	2.375"
4.	2-1/2:	5.79 (5.79 for sq. pipe at exit gate posts)	2.875"
5.	3:	7.58	3.50"
6.	3-1/2:	9.11	4.0"
7.	6:	18.97	6.625"
8.	8:	24.58	8.625"

- B. Line Posts for fencing

	Fence Height in Feet	Outside diameter in inches
1.	Less than 6 feet	1.9
2.	6 to 8	2.375
3.	8 to 12	2.875
4.	12 to 16	4.0
5.	16 to 20	6.625

- C. Terminal Posts - end, corner and slope.

	Fence Height in Feet	Outside diameter in inches
1.	Less than 6 feet	2.375
2.	6 to 8	2.875
3.	8 to 12	4.0
4.	12 to 16	6.625
5.	16 to 20	8.625

- D. Swing gate posts, single leaf; opening widths in feet:

1.	Up to 6 wide	2" diameter
2.	6-13 wide	3-1/2" diameter
3.	13-18 wide:	6" diameter
4.	18 or more wide:	8" diameter

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- E. Top rail, mid rails, and braces: 1-5/8 inches diameter, plain end, sleeve coupled.
- F. Top Rail Expansion Sleeve: 7 inches expansion sleeve with spring.
- G. Swing Gate Frames: 1-1/2 inches diameter
- H. Stiffeners for swing gates: 1-1/4 inches diameter
- I. Caps: Domed cast steel or malleable iron, galvanized and coated; sized to post dimension, set screw retained.
- J. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings: Galvanized Steel.
- K. Tension Wire: 7 gage thick coil spring steel, single strand, galvanized.
- L. Truss Rod and Tightener: 3/8-inch diameter; furnish one at each end, pull, and gate post, and at both sides of corner posts.
- M. Double Gates: Master-Halco Series 17200, latch assembly with drop rod (cane bolt).
- N. Single Gates: Refer to Paragraph 3.2 for hardware requirements as well as Gate Schedule on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with Section 304-3, SSPWC, ASTM F567 and manufacturer's instructions.
 - 1. Line post-footing diameter: 4 times the diameter of the largest core section of the post, 12 inches minimum. Embed posts into footing 6 inches less than the depth of the footing. Slope at top to shed water, 1/4" per foot.
 - 2. Line post-footing minimum depth: 36 inches deep for four feet and add 3 inches for each foot over four feet.
 - 3. Gate post-footing diameter: 16" diameter, 18" diameter for 18' - 24' gate leaf width.
 - 4. Gate post footing minimum depth: minimum 36" deep, 48" deep for 18' - 24' gate leaf width.
 - 5. For fencing higher than 12 feet: footing depth of 60" minimum and diameter of 36" minimum unless noted otherwise on drawings.
 - 6. Reinforcing: per Section 32 13 13 and as indicated on drawings.
 - 7. Posts set in hard rock concrete: drill holes 1 inch larger than post and set in non-shrink grout.
- B. Provide fence height as indicated on Drawings.
- C. Space line posts at intervals not exceeding 10 feet.
- D. Set terminal, gate and line posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.

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- E. Provide top rail through line post tops and splice with 7-inch-long rail sleeves, outside sleeve type.
- F. Brace each gate, corner, and end posts to adjacent line posts with horizontal center brace rail and diagonal truss rods. Install brace rail, one bay from end and gate posts.
- G. Center Rails: Install mid rails between posts with fittings and accessories for fabric height 12' and over, inclusive.
- H. Install center and bottom brace rail on gate leaves, welded construction.
- I. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.
- J. Position bottom of fabric 2 inches above finished grade.
- K. Fasten fabric to top rail, line posts, braces and bottom tension wire with tie wires maximum 16 inches on centers, one complete wrap.
- L. Attach fabric to end, corner and gate posts with tension bars and tension bar clips.
- M. Install bottom tension wire stretched taut between terminal posts, (corner posts shall have brace rail).
- N. Double Gates: Provide drop rod to hold inactive leaf. Provide locking device and padlock eyes as an integral part of latch, requiring for locking both gate leaves.
- O. Provide concrete center drop and drop rod retainers at center of double gate openings, except gates with panic hardware.

3.2 SWING GATES

- A. Gates that are part of the accessible route shall meet all the requirements of an accessible door in compliance with CBC 11B-404.
- B. Gate Frames: 1-1/2-inch diameter steel pipe, welded corners, hot dip galvanized after fabrication.
 - 1. Exit Gate Frames: 2-inch square steel pipe, welded corners, hot dip galvanized after fabrication.
- C. Sizes: As indicated on the Drawings, minimum widths of gates shall not be less than 36" (clearance of opening width shall not be less than 32 inches).
- D. Hardware: Heavy-duty, galvanized ferrous metal industrial quality as manufactured by Master-Halco/Anchor Fence Inc., Baltimore, MD. Von Duprin, Adams Rite, Sargent, Trimco or equal as approved in accordance with Division 01, General Requirements for substitutions.
- E. Hinges: Structurally capable of supporting gate leaf and allow opening and closing without binding. Non-lift-off type hinge design shall permit gate to swing 180 degrees as indicated on drawings.
 - 1. Latch: Fork type latch capable of retaining gate in closed position, except gates with exit devices (panic hardware); Master-Halco, Series 16000 or approved equal.

CHAINLINK FENCES AND GATES

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- a. At accessible gates, hardware shall not require pinching, grasping or twisting motion. Weld 1-1/2 inches by 2-1/2 inches by 1/4-inch diameter U-shaped galvanized rod to fork latch, both sides, for ADA accessibility as indicated on Drawings. Dress welded joints, leaving no burrs, or sharp abrasive corners, edges or surfaces, in accordance with NOMMA Guidelines for Finish 1. Touch up with Solder Zinc Alloy for Repair: Welco Gal-Viz self-fluxing solder alloy, Galvalloy, Galvabar or equal, ASTM A780, paragraph A1. Repair Using Zinc-Based Alloys.
 2. Locks: Self-latching bolt and deadbolt, 3/4-inch diameter, adjustable, lockable, with lever handle, by Ameristar Lock or equal, keyed lock. Hardware shall not require pinching, grasping or twisting motion. The lever of lever-activated latches or locks for an accessible gate shall be curved with a return to within 1/2" of the (face of) gate to prevent catching on the clothing or persons.
 3. Exit Device at Exit Gates only, outswing in accordance with 2019 CBC Sections 1008.1.9, 1008.1.10, and 1008.2, mounted 36" to 44" above finish floor. Exit Device (panic hardware) shall be mounted to provide 36" clear minimum below the device. Unlatching force does not exceed 15# applied in direction of travel.
 - a. Accessories: 4" x 3" x 1/4" x 8" high galv. steel angle welded to strike-side frame and 1" x 3" x 1/4" thick latch bolt keeper.
 - b. Fabricate Steel Lock Box, galvanized, 16 ga x 3" high x 8" wide x 1-3/4" thick to encase lockset, weld all joints and grind smooth, touch up with galvanizing compound.
 4. Locking: Provide padlock capability on non-pedestrian gates only. Do not install padlock capability on Exit Gates, gates on Path of Travel with Exit Devices and other pedestrian gates.
 5. Gate Hardware Mounting: Mount at 34 to 40 inches above walking surface and according to 2019 CBC Sections 1008.1.9 and 1008.2 and 11B-404.2.7, 11B-404.2.9.
 - a. Provide strike strap.
 - b. Bolt keeper.
 6. Install 0.125-inch-thick aluminum protective plate 24 in. high by width of gate behind panic device centered at 40 in. above finish surface. Secure to gate frame with #8 stainless steel screws at 6 in on center.
 7. Install 0.125 inch thick aluminum kickplate 10 inches high on push side (For larger gates install at both sides), CBC 11B-404.2.10, parts creating horizontal or vertical joints in these surfaces shall be within 1/16" of the same plane as the other and be free of sharp or abrasive edges. Cavities created by added kick plates shall be capped. Secure with #8 stainless steel countersunk screws 4 places each kickplate minimum. Clear space below gate shall be 3 inches maximum from walking surface on both sides of the gate.
 8. Gate Hardware: Refer to Section 08 71 00.
- F. All gates intended for pedestrian use, including ticket gates shall comply with all applicable requirements of doors, CBC Section 1010.2. All gates in the Path of Travel and as indicated on the drawings shall require Exit Devices (panic hardware) as specified above, CBC Sections 11B-404.2.7 ADAAG 4.13.3 and 11B-404.2.9. Signage is not permitted in lieu of accessible or panic hardware.
1. Gates that are part of the accessible route shall meet all the requirements of an accessible door in compliance with CBC Section 11B-404.
 2. The levers of lever actuated latches or locks for accessible gates shall be curved with a return to within 1/2" of the gate surfaces to prevent catching on the clothing or persons. California Reference Standards Code. T-24 Part 12, Section 12-10-202, Item (F).
 3. Swinging doors and gate surfaces within 10" of the finish floor or ground shall have a smooth surface on the push side extending the full width of the door or gate.

3.3 TESTING

- A. At Architect's option, Contractor shall be required to cut any pipe column after installation to confirm requirements of this Specification. If conformance is confirmed, replacement members shall be installed at Owner's cost. Components not meeting required standards shall be replaced.

END OF SECTION 32 31 13

SECTION 32 84 00 - IRRIGATION SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of the General and Supplementary Conditions and Division One apply to this section.
- B. Section Includes:
 - 1. Install a modified irrigation system including materials, equipment and procedures required for the Work.
- C. Related Sections:
 - 1. Section 32-9300: Planting.

1.02 SYSTEM DESCRIPTION

- A. Regulatory Requirements:
 - 1. Comply with local, municipal and state laws, rules and regulations governing the work.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01330; Submittals.
 - 1. Materials List: Include manufacturer's name and description of items to be furnished.
- C. Closeout Submittals:
 - 1. Submit a complete list of materials including manufacturer's name and product installation literatures.
 - 2. Record drawings: Submit dimensioned plan drawings and details, prior to completion.
- D. AS-BUILTS
 - 1. As-Builts: Four (4) copies shall be submitted, completed, and approved prior to the final inspection.
 - 2. The As-Builts shall be computer generated (Auto Cad 14 or latest version or any compatible C.A.D. program).
 - a. Prints shall show the locations of the marked remote control valves, flow sensors, master valves, manual control valves, locations and size of all supply and lateral lines, sleeves, location and type of all sprinkler heads, quick coupling valves, isolation valves, backflow devices, point of connections, controllers and all other related equipment.
 - b. Dimensions shall be legible from two permanent points of reference such as buildings and sidewalks.
 - c. Drawings shall be a full size 24" x 36" minimum.

1.04 SUBSTITUTIONS

- A. If the irrigation contractor wishes to substitute any equipment or materials for those equipment or materials listed on the irrigation specifications or job scope, the contractor

may do so by providing the following information to the Project Manager for approval:

1. The Contractor shall provide a statement indicating the reason for making a substitution, using a separate sheet of paper for each item to be substituted.
 2. The contractor shall provide descriptive catalog literature, performance charts, and flow charts for each item to be substituted illustrating that the alternate item meets or exceeds the specifications of the original item.
 3. The contractor shall provide the amount of cost saving if the substituted item is approved.
- B. The contractor shall be responsible for the total performance of such substitution to equal or surpass the original in every respect.
- C. If the substitution proves to be unsatisfactory in the opinion of the, the contractor shall remove such work and replace it with the originally specified item (including installation) at no cost to the District.
- D. The Project Manager shall have the sole responsibility for accepting or rejecting any substituted item as an approved equal to equipment and material listed on the irrigation specifications and scope of work.

1.05 QUALITY ASSURANCE

- A. Qualifications: Work shall be performed by skilled workers and by an installer licensed to perform irrigation sprinkler installation.
- B. Regulating Requirements: All local, municipal and state laws, rules, and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these specifications, and their provision shall be carried out by the contractor. Nothing contained in these specifications, however, shall be construed to conflict with any of the above rules and requirements of the same. When these specifications and drawings call for or describe materials, work, or construction of a better quality, higher standard, or larger size than is required by the above rules and regulations, the provisions of these Specifications and drawings shall take precedence.

1.06 WARRANTY

- A. Provide a one-year warranty, for labor and materials necessary to maintain sprinkler irrigation system in full operating condition.

1.07 MAINTENANCE

- A. Maintenance Manuals:
1. Provide complete operating and maintenance instruction manuals for new equipment.
- B. Extra Materials:
1. Keys and Wrenches: Provide the following items:
 - a. One coupler for each four quick coupler valves installed.

1.08 PRODUCT HANDLING

- A. Exercise care in handling, loading, unloading and storing pipe and fittings. Store materials under cover. Transport in a manner to prevent undue stresses on piping and other materials.

1.09 IRRIGATION LEAD MAN

- A. An irrigation lead man satisfactory to the Project Manager shall be present on the site at all times during the progress of work.
 - a. The lead man must be able to speak English and communicate with the Project Manager, District Inspector, and school site staff.
 - b. The lead man must be knowledgeable of the specifications and Scope of Work and have access to these documents on the project site.
 - c. The lead man shall be authorized to represent the contractor.

1.10 PROJECT CONDITIONS

- A. The contractor shall be acquainted with all site conditions and exercise extreme care in excavating and working near existing utilities. The contractor shall call Dig Alert two (2) days prior to any excavation (1-800-227-2600) and shall provide the verification number from Dig-Alert at the job start meeting. The contractor shall become familiar with all on-site underground utilities prior to any trenching.
- B. Should the contractor damage any utilities or piping during excavation or at any time on the school site, the contractor shall promptly notify the Project Manager for instruction as to further action. Failure to do so shall make the contractor liable for any damage thereto arising from his operations subsequent to discovery of such utilities not shown on plans.

1.11 INSPECTIONS: SPECIFICATIONS & SAFETY

- A. Daily inspections shall be performed without prior notice and the inspector will call upon the irrigation lead man to assist in verifying that installation meets the specifications.

Daily safety inspections will be performed without prior notice by the inspector, project manager, or school site staff. The contractor shall adhere to all safety recommendations made at the job walk or respond to any safety-related issues concerning this project. At any time the contractor receives either a verbal or written request to rectify a safety concern, s/he shall stop work and immediately correct the safety issue. Any time a contractor receives a written notice for a safety violation, s/he shall consider this a legal step to remove the contractor from this project.

- B. The contractor shall notify the inspector 24 hours in advance for the pressure side piping inspection.
- C. The contractor shall submit a request for a final inspection 48 hours in advance. When the sprinkler system has been completed, the contractor, in the presence of the District Inspector and the Project Manager, shall perform a coverage test to determine if the coverage of water to turf and planting areas is complete and adequate.
- D. The following items shall be considered part of the final inspection:
 - 1. All items and materials covered in the specifications.
 - 2. Soil compacted in trenches and around sprinkler heads, level with existing

- elevations.
3. Guarantee form and product warranty information
 4. Sprinkler control valves and boxes.
 4. Final site review and acceptance:
 - a. The contractor shall operate each system in its entirety for the District Inspector. Any system deemed not acceptable by the District Inspector, or not in compliance with these specifications and scope of work, shall be reworked to complete satisfaction of the District Inspector.

1.12 GUARANTEE

1. The guarantee for the irrigation system shall be made in accordance with the following form. The general conditions and supplementary conditions of these specifications shall be filed with the Project Manager upon completion of the project. The standard one (1) year guarantee shall include:
 - a. Filling and repairing depressions due to settlement of irrigation trenches for one (1) year following acceptance of project.
 - b. All items stated within the plans, specifications, construction notes, etc. specific to this project.
2. A copy of the signed guarantee form shall be present at the final inspection.

The guarantee form shall be on the contractor's letterhead and contain the following information:

GUARANTEE FOR SPRINKLER IRRIGATION SYSTEM

We hereby guarantee for one year from the date of acceptance by that the sprinkler irrigation system we have furnished and installed is free from defects in material and work, and the work has been completed in accordance with the specifications and the scope of work.

In the event that work performed by the contractor is faulty or defective materials are provided and/or erected/applied by him/her, the District will notify the contractor to that effect in writing. In such notice the District will order the contractor to remove (at his/her own expense) the faulty work and/or defective materials and to replace it with work and/or material that conforms to the requirements of the Contract. The District will also state in the said notice the time within which the contractor must begin the said removal and replacement and must complete the same. Upon receipt of this notice, the contractor must proceed forthwith to remove said faulty work and/or defective material from the site. The contractor shall then replace the same with new work and/or material that will conform to the provisions of the contract, using methods and materials approved by the District. The contractor shall also repair and/or replace (at his/her own expense) all work and/or material that is damaged, injured, or destroyed by the removal of said faulty work and/or defective material or by replacement of same with acceptable work and material as directed by the District Representative. If the contractor does not fix the problem within the time frame stated in the written notice, will proceed in having the repairs made and the contractor shall be responsible for all charges incurred.

Signature of Responsible Party

PROJECT:

(School or site)

CONTRACTOR:

LIC. NO.: _____

ADDRESS: _____

PHONE: _____

DATE OF ACCEPTENCE: _____

BY: (Signature of project manager) _____

Typed or printed name of Project Manager _____

NAME OF DEPARTMENT PROJECT MANAGER REPRESENTS:

BRANCH OR COMPANY NAME:

PART 2 – PRODUCTS

2.01 MATERIALS

- A. GENERAL: Use only new materials, of brands and types noted on drawings, specified herein, or approved equals.
- B. The contractor is to review all materials with supplier and allow sufficient time to order any product requiring lead-time.
- C. Pipe and Fittings:
 - 1. Plastic Pipe shall be Schedule 40 and Class 200: Extruded from 100 percent Virgin Polyvinyl Chloride (PVC) Compound, meeting requirements of Class 12454-B of "Standard Specifications for Rigid Polyvinyl Chloride Compounds and Chlorinated Polyvinyl Chloride Compounds" ASTM D 1784.
 - a. Plastic fittings shall be Schedule 40 molded from PVC Type I Compound, conforming to the requirements of Class 12454-B of ASTM D 1784.
 - b. Nipples: Schedule 80.
 - c. Plastic pipe shall be continuously and permanently marked with the following information: Manufacturer's name, nominal pipe size, Schedule or Class, SDR (Standard Dimension Ratio, or pressure rating in PSI) National Sanitation Foundation (NSF).
 - d. PVC primer and solvent for chemical weld of pipe and fittings shall be as recommended by pipe manufacturer (IPS Weld-On P-70, IPS Weld-On 2711 [gray] cement; Spears Blue 75 [SB75]). Containers for solvent and primer shall be clearly marked with manufacturer's data. Solvent and primer shall not be more than one year old. Blue or red-hot glue shall not be used on the project.
 - 2. Connection between steel pipe and copper pipe or tube shall use a brass nipple.
 - 3. Connection between any female threaded fitting and plastic pipe shall be made with

- a Schedule 80 nipple.
 - 4. Steel pipe or fittings shall not be used underground.
 - 5. Brass Pipe: Seamless, 85 percent red brass, iron pipe sized, threaded.
 - 6. Brass Fittings: Bronze and brass 250 PSI, screwed, A.S.A. B16.17 and FSWW-P-460.
- D. Shut-off Valves:
- 1. Gate valves on pipe 3-inch and larger shall be A.W.W.A. Specification, Class "D" dimensions caulk bells, or standard flanged, or a combination of outlets as required, iron body, brass trimmed, non-rising stem with operating nut. Gate valves 2-inch or smaller shall be bronze, non-rising stem, screwed.
 - 2. Quick coupler valves shall be all brass, 1-inch, with lock top and rubber cap.
 - a. Quills shall be the same manufacturer as quick coupler valve, cast bronze, machine shank, stainless steel or bronze lugs.
 - 3. Couplers shall be same manufacturer as quick coupler valve, cast bronze, machined shank, stainless steel or bronze lugs.
 - 4. Electric remote control valves shall be 24-volts capable of operating on #14 gauge UF wire; either bronze or brass, globe or angle pattern, and diaphragm actuated.
- E. YARD BOXES AND REMOTE CONTROL BOXES
- 1. Yard boxes installed in pavement shall be Brooks 4-TT 10-1/4" traffic box with cast iron traffic cover marked "Irrigation", or larger, as may be required to obtain specified clearance.
 - 2. Pull boxes to be Brooks 3-1/2 (T) PB 10" x 17" pull box w/full bolt-down traffic cover marked "Irrigation".
 - 3. Remote control valve boxes for turf areas or shrub areas shall be Carson, or approved equal, large rectangular. Use Cover with Captive Pentahead "L" Bolt.
- F. CONTROLLER:
- 1. Manufacturer
 - a. Existing
- G. Irrigation Wire: Paige - P7079D, or approved equal
- H. Gate Valve: NIBCO Model T113, or approved equal
- I. Remote Control Valve: Per Plans
- J. Ball Valves: Per Plans
- Q. Pop-up Gear Driven Rotor: Hunter Model I20-04-SS, or approved equal
- R. Rotary Spray Nozzles: Rainbird or Hunter.
- S. Valve Boxes: Carson, or approved equal.
- T. Valve ID Tags: Christy, or approved equal
- U. Irrigation Piping:
- 1. All piping to be PVC Schedule 40
 - 2. PVC fittings: Spears or approved equal
 - 3. PVC Mainline Solvent: Weld-on - 2711 - Heavy
 - 4. PVC Lateral Line Solvent: Weld-on - 2721 - Medium
 - 5. PVC Primer - Weld-on - P-70
- V. Performance Requirements
- 1. Minimum Working Pressures:
 - a. Irrigation Main Piping: 200 psi.
 - b. Circuit Piping: 150 psi.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Piping and devices shall be supported to maintain uniform alignment and prevent sagging by installing hangers and anchors of sufficient strength to support the weight of the pipe and its contents.
- B. Isolate piping from incompatible materials.

3.02 LAYING PIPE

- A. Trenches shall be deep enough to provide earth coverage of 12-inch for non-pressure lines and 18-inch for pressure lines, from finished grades to top of pipe. The bottom of trenches shall be free of rocks, clods, and other sharp-edged objects. Piping in ground shall be laid on a firm bed for its entire length.
- B. Plastic pipe and fittings 2" and below shall be Schedule 40 PVC solvent welded, using solvents and methods recommended by the pipe manufacturer. Plastic pipe 3" and larger shall be gasket Class 200 PVC. Remove all dust, dirt and moisture from pipes and fittings before applying primer and solvent; wipe excess solvent from joints with a clean rag. Primer shall be used on all PVC glued joints, pressure and non-pressure piping.
- C. Welded joints shall cure at least 15 minutes before moving or handling and at least 24 hours before water will be permitted in pipe, or as recommended by manufacturer.
- D. Pressure piping installed under a driveway or sidewalk shall be sleeved; sleeves shall be two pipe sizes larger.
- E. Piping through concrete and asphalt pavement shall be L type copper with ¼-inch of foam wrap around the pipe to allow for expansion.
- F. Holes cored through walls shall be two pipe sizes larger to allow for foam wrap around pipe.
- G. PVC pipes shall not be installed above ground unless approved by the District Inspector.
- H. Lettering shall be facing up on all under ground PVC piping.

3.03 IRRIGATION HEAD INSTALLATION

- A. After installation, examine system operation for complete coverage. Make adjustments, as may be required to provide complete coverage.
- B. Branch lines, swing joints or sprinkler risers shall not be sized smaller than the sprinkler heads they serve.

3.04 YARD BOX INSTALLATION

- A. Enclose underground gate valves in yard boxes of sufficient size to provide no less than 1 1/2-inch of clearance on all sides of equipment installed therein.

- B. Sides and ends of yard boxes shall be extended down to the centerline of the main line when the main is more than ¼-inch below the bottom of the box. The box shall enclose all shut-off valves below ground.
- C. Yard boxes in paved areas shall be set in a concrete bed 4-inches thick with a clearance of at least 1-inch below pipe or below the walls of the box.
- D. Yard and remote boxes shall be installed level to grade.

3.05 REMOTE CONTROL VALVE BOX INSTALLATION

- A. The remote control valve box shall extend to the body of the valve, and box tops shall be 2-inches above finished grade in ground-cover areas. In turf areas, the top of the box shall be flush with finished turf grade. In paved areas, box tops shall be flush with finished grade. Plastic yard box covers shall be bolted down.
- B. Pea gravel shall be filled up to the bottom of the manual and remote valve and there shall be at least 4-inches of gravel inside of the valve box.
- C. Emboss or "Brand" remote box lids with 3-inch size numbers, showing number that corresponds with controller station and a 3-inch size letter to show which controller it serves. There shall be one remote valve for each remote box.

3.06 QUICK COUPLER VALVES AND ASSEMBLIES

- A. Install quick couplers 1-inch above finished grade.

3.07 VALVES

- A. Pressure piping system shall be supplied with valves at all points where required.
- B. Valves shall be installed with the best of workmanship, neat appearance and groupings; so all parts are easily accessible. Valves near walk curbs and appurtenances shall be set back 12-inches.
- C. Valves shall be full size of line in which they are installed unless otherwise indicated.
- D. Remote Control Valves & Manual Sprinkler Valves:
 - 1. Remote control valves shall be low wattage (24-volts) and shall be capable of operating properly on no larger than #14 gauge UF wire.
 - 2. Remote control valves shall be adjustable to control flow of water through valve adjustments and shall be accessible through valve boxes installed above each valve.
 - 3. Remote control valves shall be installed and adjusted so that sprinkler heads operate at pressure recommended by head manufacturer. Remote control valves shall be adjusted so that a uniform distribution of water is applied by sprinkler heads to planting areas from each individual valve system.
 - 4. Remote control valves on any line shall be installed 3-inches minimum and 8-inches maximum below finish grade to top of flow control stem.
 - 5. Remote control valves shall be installed with schedule 80 nipples on the inlet and

outlet side of valve.

6. Manual and remote control valves for lawn and shrub areas shall be installed within the perimeter of the area it serves.
7. Manual and remote control valves for all athletic fields shall be installed in the following specified location:
 - a. Control valves shall be grouped together, installed on the perimeter of the athletic field and installed in yard boxes.
 - b. Provide Manual operating key to District.

3.09 CONTROL WIRE

- A. Re-use of existing. Provide splices as necessary and install in an 8" round plastic valve box. Bundle 18" of control wire inside box. Locate splice box in planter area.

3.10 VERIFICATION AND TESTING

- A. The contractor shall notify District Inspector 24 hours in advance for the pressure side piping inspection.
 1. Pressure Side Piping: After all pressure-side equipment has been installed (gate valves, remote control valves, quick-couplers, etc), welded joints have cured for at least 24 hours, lines are flushed, and outlets are capped, the system shall be tested under local water pressure plus 20% for a minimum of 4 hours. Joints shall remain exposed for inspection during the pressure test. The contractor may center load pipe with back fill to prevent arching or slipping under pressure.
 2. Repair leaks and repeat pressure test, until the entire system is watertight.
- B. Perform a coverage test to determine if the coverage of water to turf and planting areas is complete and adequate.
 1. Final site review and acceptance:
 - a. The contractor shall operate each system in its entirety. Features of system deemed unacceptable shall be reworked, and the coverage test repeated.

3.11 CLEAN-UP

- A. Clean up shall be performed as each portion of work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be broomed and washed down, and any damage sustained to the work of others shall be repaired and work returned to its original condition.

END OF SECTION

SECTION 32 93 00 - PLANTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of the General and Supplementary Conditions and Division One apply to this section.
- B. Section Includes:
 - 1. Labor, materials and equipment required to complete landscape planting, as indicated.
- C. Related Sections:
 - 1. Section 32-8400: Irrigation System.

1.02 SUBMITTALS

- A. Material Samples:
 - 1. Fertilization: Contractor shall furnish the Project Manager with delivery receipts for soil amendment materials to substantiate applications.
 - 2. Pesticides: Submit manufacturer's literature and application methods for each pesticide proposed for use.
- B. Certificates:
 - 1. Submit a certificate with each delivery of bulk material, including import soil, stating source, quantity, and type of material, and that material conforms to Specification requirements.

1.03 QUALITY ASSURANCE

- A. Plant Materials:
 - 1. Plant materials shall be furnished in the quantities or spacing as shown or noted for each location, and shall be of the species, kinds, sizes and types, per symbol or as described on the Drawings.
 - 2. All plant material will be inspected at the project site and inspected for conformance to these specifications.
- B. Verification of Dimensions and Quantities: Before proceeding with work, Contractor shall carefully check and verify dimensions and quantities and shall immediately inform the Landscape Architect and the Project Manager of any discrepancies between Drawings and Specification and actual conditions.
- C. Protection: Carefully and continuously protect areas included in work, such as lawns, plant materials, fences and supports, until final acceptance of the work by the District Inspector.
- D. Pest Management Method and Products:
 - 1. Only pest management methods and products demonstrated to be safest and lowest risk

to children will be used, those products that will not cause or those that will have the least health effects as cancer, neurological disruption, birth defects, genetic alteration, reproductive harm, immune system dysfunction, endocrine disruption and acute poisoning. Pest management methods and products used in the execution of this contract shall be in strict conformance with the F.U.S.D.

2. Only pest management products that can be applied in a manner and at a time where no person can inhale or come into direct contact with them, or be exposed to volatile agents shall be used.

E. Quality Assurance

1. Installer's Personnel Certifications: Certified Landscape Technician, CLT-Exterior.
2. Soil analysis of each un-amended soil type.

F. Maintenance Service

1. Trees and Shrubs: 3-months.
2. Other Plants: 3-months

1.04 DELIVERY, STORAGE AND HANDLING

- A. Plants shall be protected in transit and after delivery to project site. Plants in broken containers will not be accepted and plants with broken branches or injured trunks will be rejected.
- B. Plant materials damaged in planting operations shall be replaced.

1.05 WARRANTY

- A. Shrubs and groundcover shall be guaranteed for growth and health for a period of 90 days after completion of maintenance period. Trees shall be guaranteed by Contractor to live and grow in upright position for a period of one year after completion of the maintenance period.
- B. Within 15 days after notification by the District Inspector, remove and replace plant materials that fail. Replacement materials shall be guaranteed as specified for original plant materials.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Soil Conditioners:

1. Gro-Power Plus (bacteria included) with 1.25 percent soil penetrant and consisting of the following percents by weight: 5-nitrogen, 3-phosphoric acid, 1-potash, 50-humus, 15-humic acid.
2. Nitrolized Redwood Sawdust: Containing minimum 0.5 percent nitrogen based on dry weight.
3. Shavings shall be mill-run shavings, not sawdust, nitrolized with a minimum of 1/2 percent nitrogen.

B. Pest Management Methods and Products

1. Pesticides (insecticides, herbicides, fungicides, rodenticides, avicides and growth regulators) shall not contain any ingredients (both active and inert) that are:

- a. Banned, suspended, cancelled, discontinued or withdrawn by United States Environmental Protection Agency or Department of Pesticide Regulation of California Environmental Protection Agency.
 - b. Not registered for the intended use with above agencies.
 - c. Known or suspected to be a carcinogen according to International Agency for Research on Cancer (IARC), United States Department of Health and Human Services - National Toxicology Program (USDHHD-NTP), United States Department of Labor-Occupational Health and Safety Administration (USDOL-OSHA), California Safe Drinking Water and Toxic Enforcement Act of 1986 (Prop 65).
 - d. Known to be mutagenic, teratogenic, oncogenic, neurotoxic, or cause reproductive hazards in humans.
 - e. Listed as Class I Pesticides (extremely toxic) or labeled as "Danger".
 - f. Classified as Highly Toxic by USDOL-OSHA if mode of application is spraying or broadcast-spreading.
- C. Plant Materials: Plant materials indicated on Drawings and specified shall conform to the following:
1. Nomenclature: Plant names on Drawings conform to "Standard Plant Names" established by the American Joint Committee on Horticultural Nomenclature; names not covered therein follow established nursery lexicon.
 2. Condition: Plants shall be symmetrical, typical for variety and species, sound, healthy, vigorous, free from plant disease, insect pests or their eggs. Plants shall have healthy, normal root systems, well filling their containers, but not root bound. Plants shall not be pruned prior to delivery except as authorized by the Landscape Architect.
 3. Dimensions: Height and spread of all plant material shall be as indicated and shall be measured with branches in their normal position. Caliper of trees shall be measured 4-feet above surface of ground. Where caliper or other dimensions of any plant materials are omitted, it shall be understood that these plant materials shall be normal stock for type listed.
 4. Groundcover plants shall be well rooted in flats or containers.
 5. Plants, General: Nursery-grown and complying with ANSI Z60.1.

PART 3 - EXECUTION

3.00 Planting required 90-days, minimum prior to occupancy.

3.01 EXAMINATIONS

- A. Contractor shall schedule following inspections. Notify the District Inspector:
 1. When planting, sowing and other indicated.
 2. At the completion of the maintenance period as final inspection.
- B. Plant materials shall be subject to examination by photographs and approval of the Landscape Architect before planting.
- C. Contractor shall make a request to the Project Manager for a check inspection allowing 2 calendar days notice from completion of construction and planting operations. This examination with approval of the Landscape Architect, will establish start of Maintenance

Period.

3.02 GRADING AND SOIL PREPARATION

A. Preliminary Grading:

1. Preliminary grading shall be done in such a manner as to anticipate finish grading. Import soil, where used, shall be dug into top 2-inches of the existing soil. Excess soil shall be removed or redistributed before application of soil amendments. Allowance shall be made so that when finish grading has begun there shall be no deficiency in specified depth of mulched planting beds.
2. Moisture Content: Soil shall not be worked when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in air or that clods will not break readily. Water shall be applied, if necessary, to provide ideal moisture content for tilling and for planting.
3. Weeding: After soil preparation and establishment of final grades prior to any planting, Contractor shall irrigate thoroughly all planter areas for a period 2 to 3 weeks or until weed seeds have germinated. When there is sufficient weed seed germination, Contractor shall apply a post-emergent weed killer. Contractor shall then wait an additional one week to allow weed killer to dissipate, then plant as indicated on Drawings and Specifications.

B. Finish Grading:

1. When preliminary grading, including weeding and amendments, has been completed and soil has dried sufficiently to be readily worked, planting areas shall be graded to elevations indicated on Drawings. Grades not otherwise indicated shall be uniform levels or slopes between points where elevations are given. Minor adjustments of finish grades, if required, shall be made at the direction of the Landscape Architect. Finish grades shall be smooth, even, and at uniform planes with no abrupt change of surface. Soil areas adjacent to buildings shall slope away from buildings to allow a natural runoff of water, and surface drainage shall be as indicated on Drawings.
Low spots and pockets shall be graded to drain properly. Finish grade of planting and lawn areas shall be 1 1/2-inches below grade adjacent to pavement.

C. Prepared Soil: Soil backfill in pits for trees, shrubs, vines, and for planter boxes shall be a prepared soil consisting of 2-parts nitrolized sawdust and 8-parts native on-site soil, measured by volume, to which shall be added 2-pounds of Gro-Power Plus per cubic yard of mix. Prepared soil shall be mixed in areas adjacent to planting work, and shall be accurately proportioned, using a suitable measuring container such as a wheelbarrow of measured capacity.

3.03 METHOD OF PLANTING

- A. No planting shall be done until operations in conjunction with installation of sprinkler system have been completed, final grades have been approved, concrete and redwood headers have been installed, planting areas have been prepared as specified, and work tested and approved.
- B. Relative position of trees and plants is subject to approval of the Landscape Architect, and they shall, if necessary, be repositioned as directed at no additional cost to the District.

- C. Plants shall be set so that, when settled, they bear same relation to the required grade as they bore to natural grade – plus 2" - before being transplanted. Each plant shall be planted in center of pit and backfilled with prepared soil. No soil in muddy condition shall be used for backfilling. No filling will be permitted around trunks or stems. Broken or frayed roots shall be properly cut off.
- D. Shrubs, unless otherwise indicated, shall be placed a minimum of 30-inches from buildings, walls, and fences.
- E. Planting of Trees: Pits for trees shall be dug square with bottom level, length of sides equal to 2 times diameter of ball of tree and bottoms 8-inches below ball, except in paved areas, minimum length of sides shall be 4-feet and minimum depth 3-feet. Compacted soil at sides and bottoms shall be loosened by scarifying or other approved method. Pits shall be back-filled with compacted, prepared soil to bottom of the tree ball, tree set to required grade, balance of pit filled with prepared soil, and thoroughly settled by tamping and watering. Top of rootball/container shall be 4" above edge of water basin. Slope backfill towards mound, away from trunk. No water basin required for trees planted in gravel or on a slope.
- F. Planting of Shrubs and Vines: Shrubs and vines shall be planted in pits at least 12-inches greater in diameter than ball of earth and at least 6-inches below bottom of ball. Compacted soil at bottom of pit shall be loosened and pit filled with prepared soil to bottom of ball. When plant has been properly set, pit shall be filled to the required grade with prepared soil, thoroughly settled by tamping and watering.
- G. Mulching: Per plans.
- I. Watering Basins: Not Applicable to this project.

3.04 TREE SUPPORTS

- A. Use 3 stakes in paved areas and 2 stakes in planting areas. Stakes shall be at least 10-feet long, placed and driven as indicated on drawings. Fasten stakes together and to trees per details.
- B. Placement: Stakes shall be located to prevent interference with operation of sprinkler system. If necessary, stakes shall be relocated as required or directed.

3.05 PESTICIDE APPLICATION

- A. Application rates and methods shall conform to written recommendations of manufacturer and shall comply with regulations of San Bernardino County Agricultural Commissioner and the Department of Agriculture, State of California.
- B. Only well trained, competent operators shall be allowed to apply pesticides.
- C. Certificated applicators shall be used wherever required by regulations of the County, or the State of California or as determined by the District IPM Coordinator.

- D. Pesticide application shall be performed in accordance with pertinent State and Federal laws and regulations. In addition, application shall be performed under following conditions, but not limited to:
- a. Posting warning sign according to District policy, verify.
 - b. Using low pressure spraying when permitted.
 - c. Strict adherence to manufacturer's recommended re-entry period after application.
 - d. Pesticides shall be used in strict conformance to manufacturer's instructions on product labeling.
 - e. Applicators shall use appropriate personal protective equipment recommended in accordance with product labeling. They include body coveralls, respirators, splash goggles and rubber gloves.

3.06 FINAL INSPECTION

- A. Schedule the following inspections and notify the District Inspector:
1. When planting, sowing and other indicated or specified work, except maintenance work, has been completed.
 2. Final inspection at the completion of the maintenance period.
- B. Plant materials shall be subject to inspection and approval of the District before planting.
- C. After completion of construction and planting operations, request for a check inspection. Allow at least 2 days notice prior to inspection. This inspection, with the approval of the District, will establish the start of the landscape maintenance period.
- D. Upon completion of the landscape maintenance period, request for a final inspection. Allow at least 2 days notice prior to inspection.

3.07 MAINTENANCE

- A. Contractor shall continuously maintain areas included in Contract during progress of work, maintenance period, and until final acceptance of work.
- B. Maintenance period shall be for a minimum of 90 days.
- C. Maintenance shall be continued by Contractor if plant materials are not acceptable at end of Contract, or until acceptance by the District.
- D. Maintenance shall include continuous operations of watering, weeding, trimming, edging, cultivating, fertilizing, spraying, insect and pest control, replacement or any other operations necessary to ensure good normal growth.
- E. During installation period and during maintenance period, Contractor shall be responsible for maintaining adequate protection for planted areas.
- F. At completion of maintenance period plant materials shall be alive, healthy, undamaged and free of infestations.

- G. Replacements: Contractor shall replace plant materials and grass that is dead or damaged. Replacements shall meet requirements for original plantings.
- H. Planted areas shall be kept free of debris, and shall be cultivated and weeded at not more than 10-day intervals. Grass, when 2-1/2-inches high, shall be mowed to a 1-inch height. Once established, grass shall be mowed at least once per week during maintenance period.
- I. Water plantings adequately to ensure complete germination of seed and continued growth of plants.
- J. In areas that do not have sprinkler coverage or which may require supplemental deep watering. Hose watering or temporary sprinklers on stands shall accomplish this.
- K. Chemical herbicides may be used to control weeds when approved by the Campus IPM Coordinator.
- L. Weed Control on Shrub Beds: Apply pre-emergent herbicide after planting. Herbicide shall be approved for use by the State and County and shall have minimal detrimental effect on groundcover plants. Rate and method of application shall conform to the written recommendations of manufacturer.
- M. New Trees: Broadcast commercial fertilizer over planting pit at rate of 1/2 pound for every inch of trunk caliper and water immediately. Repeat approximately 30 to 45 days after start of maintenance or after tree has produced definite signs of establishing itself after transplant and is producing new growth, whichever is first.
- N. Shrub Areas: Fertilization: Shrub areas shall receive an application of commercial fertilizer at rate of 2-pounds per 1,000 square feet 30 days after start of maintenance. Irrigate after application.
- R. Insect and Fungus Control: Contractor shall be alert for signs of insect presence or presence of damage from plant fungi. Upon locating such evidence, Contractor shall report matter to the District Pest Control Specialist and take remedial action as directed by the District IPM Coordinator.

3.08 CLEAN UP

- A. Upon completion of planting operations and maintenance period, remove equipment and clean site of debris and superfluous materials.

END OF SECTION

SECTION 33 40 00 – STORM DRAINAGE SYSTEMS

PART 1 - GENERAL

All applicable portions of Division 1, including the drawings and general provisions of the contract, the general and supplementary conditions and Division 1 specifications sections which apply to work of this section as if printed herein.

1.1 WORK INCLUDED:

- 1.1.1 Work includes storm drain lines and related storm drain structures.

1.2 RELATED WORK:

1.2.1 Related Work Specified Elsewhere:

- 1.2.1.1 Section 017123 - Field Engineering: Location, elevations and inverts of storm drainage lines and structures.
- 1.2.1.2 Section 312200 - Earthwork.
- 1.2.1.3 Section 312300 – Excavating and Backfilling for Utilities
- 1.2.1.4 Section 15400 - Plumbing Systems: Roof drainage piping within five feet of building lines.

1.3 QUALITY ASSURANCE:

1.3.1 Regulatory Requirements:

- 1.3.1.1 Comply with applicable codes and regulations of governmental agencies having jurisdiction.
- 1.3.1.2 Where requirements of applicable codes, regulations and standards conflict with this Specification, comply with the more stringent provisions.

1.3.2 Source Quality Control:

- 1.3.2.1 Tests: Materials for which physical characteristics have been stipulated shall have had such characteristics independently confirmed by laboratory tests employing industry-recognized procedures. Both the laboratory performing the tests and the test methods employed will be subject to the approval of the Architect.

1.4 REFERENCES:

1.4.1 American Society for Testing and Materials (ASTM):

- 1.4.1.1 C 412 - Specifications for Extra Strength Clay Pipe.
- 1.4.1.2 C 478 - Specifications for Precast Reinforced Concrete Manhole Sections.

1.4.1.3 C 139 - Specifications for Concrete Masonry Units for Construction of Catch Basins and Manholes.

1.5 SUBMITTALS:

1.5.1 Product Data: Submit complete manufacturer's description literature and specifications in accordance with the provisions of Section 013300.

1.5.1.1 Materials List: Submit complete lists of materials proposed for use, giving the manufacturer's name, catalog number, and catalog cut for each item where applicable.

1.5.2 Shop Drawings: Submit in accordance with Section 013300 for approval for all frames, grates, manholes and manhole steps, catch basins, inlets, pipe materials and joints.

1.6 DELIVERY, STORAGE, AND HANDLING:

1.6.1 Protection: Use all means necessary to protect the materials of this Section before, during, and after installation.

PART 2 - PRODUCTS

2.1 MATERIALS:

2.1.1 Storm Sewer Pipe:

2.1.1.1 Corrugated PE Pipe and Fittings NPS 10 and smaller: AASHTO M 252M, Type S, with smooth waterway for coupling joints.

2.1.1.1.2 Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings to form silttight joints.

2.1.1.2 Corrugated PE Pipe and Fittings NPS 12 to NPS 48: AASHTO M 294, Type S, with smooth waterway for coupling joints.

2.1.1.2.2 Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings to form silttight joints

2.1.1.3 PVC Sewer Pipe and Fittings: NPS 15 and Smaller: ASTM D 3034, SDR 35, for solvent-cemented or gasketed joints.

2.1.1.3.1 Gaskets: ASTM F 477, elastomeric seals.

2.1.1.3 All storm sewer systems to have water tight seals.

2.1.2 Bedding Material For Storm Sewer: In accordance with Section 312300 Excavation and Backfill for Utilities.

2.2 UTILITY STRUCTURES:

2.2.1 New storm utility structures shall be constructed as detailed on the Drawings and be one of the following:

- 2.2.1.1 Precast reinforced concrete manhole riser sections conforming to ASTM C 478.
- 2.2.1.2 Cast-in-place concrete of 3,000 psi strength. Concrete used for utility structures shall conform to requirements specified in Section 033000.
- 2.2.2 Mortar for jointing precast-segmental masonry units and joining sewer to new storm manholes shall be Type S and consist of one part Portland cement to one part plaster sand, mixed with the least amount of clean water necessary to provide a workable mortar. Mortar shall meet requirements of ASTM C 387.
- 2.2.3 Concrete Fill for Benching Manhole Structures: Concrete shall be mixed with the least amount of clean water and shall have a minimum strength of 3,000 psi and conform to ASTM C 387.
- 2.2.4 Steps for New Storm Sewer Manhole Concrete Structures: Cast iron conforming to ASTM A 48 or hot-dipped galvanized steel bar or as detailed on the drawings. Provide steps on storm manholes where the invert is 2 feet or more from the bottom of the cast iron frame. All manholes shall be manufactured and installed per local or county codes and regulations. All manhole covers to be flush with grade.
- 2.2.5 Cast Iron Frames, Grates and Covers for Storm Sewer Structures: Gray cast iron castings conforming to ASTM A 48 and be of type and configuration as noted or detailed. All grates and covers shall be painted if located in a concrete walkway. Color as selected by the Architect. Grates maximum openings within a walkway or paved area shall be 1/2 inch wide. Perpendicular to path of travel CBC 11B-302.3.

2.3 CATCH BASINS

- 2.3.1 Standard Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 - 2.3.1.1 Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 - 2.3.1.2 Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
 - 2.3.1.3 Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 - 2.3.1.4 Joint Sealant: ASTM C 990, bitumen or butyl rubber.
 - 2.3.1.5 Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
 - 2.3.1.6 Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and grate.
 - 2.3.1.7 Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

PART 3 - EXECUTION

3.1 INSPECTION:

- 3.1.1 Prior to Work of this Section, carefully inspect Work of all other trades and verify that such work is complete to the point where this installation may properly commence.

- 3.1.2 Verify that work of this Section may be installed in accordance with all pertinent codes and regulations, the original design, and the referenced standards.

3.2 PREPARATION:

- 3.2.1 Field Measurements: Lay out and stake all storm sewer piping at 25 foot intervals at all structures, ends of pipe, etc., before starting excavation.
- 3.2.2 Protection: Protect the installed work and materials of all other trades which may be affected by work of this Section.

3.3 INSTALLATION:

- 3.3.1 Excavating and Backfilling for Storm Sewer System: Excavate, trench and backfill in accordance with Section 312300. Trenches under parking areas, sidewalks, etc., shall be entirely backfilled with selected granular material only.
 - 3.3.1.1 Provide and maintain sufficient barricades and warning devices adjacent to excavation to safeguard against injury to workmen and the public at all times.
 - 3.3.1.2 After installation of piping and equipment have been completed, backfill all excavations in accordance with Section 312300.
 - 3.3.1.3 Where excavation is necessary in existing pavement, the Contractor is required to pay all fees and permit costs of opening street or pavement and all costs of filling and repaving in accordance with requirements of and to the satisfaction of the Municipality, Utility, or other Owner of such paving.
 - 3.3.1.4 Removal of subsurface obstructions which are uncovered during excavation for installation of the utility systems specified herein shall be removed by the Contractor at his expense, up to 2 feet below the bottom of the lineal pipe run or invert of catch basins and/or drainage structures.
- 3.3.2 Bedding:
 - 3.3.2.1 Bedding for storm sewers shall be installed a minimum of 6 inches deep beneath the bottom of pipe to provide a granular cushion between the pipe and the natural soil. Refer to Section 312300 for further information.
 - 3.3.2.2 The pipe bedding shall be placed so that the entire length of the pipe will have full bearing. No blocking of any kind shall be used to adjust the pipe to grade except when used with granular bedding.
 - 3.3.2.3 Bedding backfill shall continue to a minimum of 12 inches on top of pipe, for final trench backfill.
- 3.3.3 Construction of Underground Utility Structures:
 - 3.3.3.1 All structures shall be constructed so that no water pipe is in contact with or enclosed by any part of a sewer manhole or other similar structures.
 - 3.3.3.2 Precast sections shall be sealed with mastic joint sealer. Prior to joining the sections, all gasket and pipe surfaces to be joined shall be clean and dry. All lifting holes shall be filled with mortar.

3.3.3.3 Inlet and outlet pipes for structures shall extend outside the walls a sufficient distance to allow for connections. Special care shall be taken to see that the openings through which pipes enter structures are completely sealed with mortar. The bottoms of all structures indicated on the Drawings shall be filled with 3,000 psi strength concrete and shaped to provide smooth channels from the lowest inlet pipe entering the structure to the outlet pipe.

3.3.3.4 Cast iron frames shall be accurately set in full 1 inch mortar beds to finish elevation.

3.3.3.5 Plugs and connections: When specified in Drawings, stubs or other open ends which are not to be immediately connected shall be made of an approved material and shall be secured in place.

3.3.3.6 Use commercially manufactured wyes for branch connections.

3.4 FIELD QUALITY CONTROL:

3.4.1 Tests: Upon completion of this portion of the Work, and prior to its acceptance by the Owner, make all required tests and secure all required approvals from agencies having jurisdiction.

3.4.2 Provide the Owner proof that all storm drainage and pipe, devices, flow to the main storm drain piping and no clogging occurs. If clogging occurs, the Contractor shall remove any and all debris, rocks and dirt from the clogged pipe and/or drainage structure at no cost to the Owner.

3.5 ADJUSTING AND CLEANING:

3.5.1 At the completion of the work specified herein and prior to the Owner's final acceptance, all sediment and debris shall be removed from all storm sewers and their structures.

3.5.2 Provide a camera for storm drain pipe exploration where storm drainage devices backed up or will not flow through. All camera(s), devices, film and camera exploration shall be at Contractor's expense.

END OF SECTION