

**Arroyo High School
Modernization**

4921 Cedar Ave., El Monte CA 91732

3361-008-000

El Monte Union HS District



June 15, 2023

ARROYO HIGH SCHOOL - MODERNIZATION
EL MONTE, CALIFORNIA
DSA SUBMITTAL

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1.01 DESIGN PROFESSIONALS OF RECORD

A. Architect:

1. Virginia Marquardt
2. C-33423



B. Civil Engineer:

1. Virgilio C. Aoanan
2. C-36079



C. Plumbing/HVAC Engineer:

1. Sunil Patel
2. M-29448



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- D. Electrical Engineer:
1. Manan H Christian
2. E-22864



END OF DOCUMENT 000107

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SECTION 00 26 00 - PROCUREMENT SUBSTITUTION PROCEDURES

1.01 SUMMARY

- A. Section Includes: Requirements for substitution requests made during procurement.
- B. Related Sections:
 - 1. Section 01 25 00 - Substitution Procedures: For requirements for substitution requests made after Contract award.

1.02 DEFINITIONS

- A. Bidder: Entity or individual authorized to submit a bid in accordance with the Bidding Documents with the intention and ability to enter into an agreement with the Owner to perform the Work.
- B. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.

1.03 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.

1.04 PROCUREMENT SUBSTITUTIONS

- A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents.
- B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:
 - 1. Extensive revisions to the Contract Documents are not required.
 - 2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
 - 3. The request is fully documented and properly submitted.

1.05 SUBMITTALS

- A. Procurement Substitution Request: Submit to Architect. Procurement Substitution Request must be made in writing by prime contract Bidder only in compliance with the following requirements:

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1. Requests for substitution of materials and equipment will be considered if received no later than 10 days prior to date of bid opening.
 2. Submit three copies of each request for consideration, using facsimile of form provided in the Project Manual.
 3. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 4. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specifications Sections and drawing numbers.
 5. Provide complete documentation on both the product specified and the proposed substitute, including the following information as appropriate:
 6. Point-by-point comparison of specified and proposed substitute product data, fabrication drawings, and installation procedures.
 7. Copies of current, independent third-party test data of salient product or system characteristics.
 8. Samples where applicable or when requested by Architect.
 9. Detailed comparison of significant qualities of the proposed substitute with those of the Work specified. 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.
 10. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 11. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, which will become necessary to accommodate the proposed substitute.
 12. Provide certification by manufacturer that the substitute proposed is equal to or superior to that required by the Procurement and Contracting Documents, and that its in-place performance will be equal to or superior to the product or equipment specified in the application indicated.
 13. Bidder, in submitting the Procurement Substitution Request, waives the right to additional payment or an extension of Contract Time because of the failure of the substitute to perform as represented in the Procurement Substitution Request.
- B. Architect's Action:
1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all bidders of acceptance of the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.
 - a. Substitution requests submitted by entities or individuals other than Bidders will be discarded.
- C. Architect's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

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SECTION 00 72 00 - GENERAL CONDITIONS

1.01 GENERAL CONDITIONS

- A. The following form of the General Conditions shall be used for Project:
 - 1. The General Conditions for Project are General Conditions as provided by Owner.
- B. The General Conditions are available upon request.

END OF DOCUMENT

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SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Work covered by Contract Documents.
 2. Contractor's use of site and premises.
 3. Work restrictions.
 4. Specification and Drawing conventions.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
1. BUILDING R - NEW INTERIOR FINISHES, EXTERIOR PAINT, ROOFING, LIGHTING FIXTURES, FIRE ALARM DEVICES, HVAC UNIT, AND PATH OF TRAVEL.
 2. BUILDING K - NEW TYPE 1 KITCHEN HOOD WITH SUPPRESSION SYSTEM AND HVAC UNIT.

1.03 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Unrestricted Use of Site: 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. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
1. Driveways, Walkways, and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

1.04 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

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- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of <Insert time> a.m. to <Insert time> p.m., Monday through Friday, unless otherwise indicated.
- 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 Architect not less than [two] <Insert number> days in advance of proposed utility interruptions.
 - 2. Obtain Architect's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Architect not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.

1.05 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 - 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 - 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.

1.02 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.

1.03 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. 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.

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- i. 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.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. 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.
 - l. 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.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- 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.

1.04 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.

1.05 PROCEDURES

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

1.06 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 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.

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- 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: Not allowed[**unless otherwise indicated**].

C. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.

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 offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
- b. Requested substitution does not require extensive revisions to the Contract Documents.
- c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
- d. Substitution request is fully documented and properly submitted.
- e. Requested substitution will not adversely affect Contractor's construction schedule.
- f. Requested substitution has received necessary approvals of authorities having jurisdiction.
- g. Requested substitution is compatible with other portions of the Work.
- h. Requested substitution has been coordinated with other portions of the Work.
- i. Requested substitution provides specified warranty.
- j. 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.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections:
 - 1. Section 01 26 73 "DSA Construction Change Document Procedures" for contract modifications of portions of the project affecting the Structural Safety, Access Compliance, and Fire and Life Safety.

1.02 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.

1.03 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - 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.
 - e. Quotation Form: Use forms acceptable to Architect.

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- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 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.
 7. Proposal Request Form: Use form acceptable to Architect.

1.04 CHANGE ORDER PROCEDURES

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

1.05 CONSTRUCTION CHANGE DIRECTIVE

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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CONTRACT MODIFICATION PROCEDURES
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SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.02 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 at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Arrange schedule of values consistent with format of AIA Document G703.
 - 2. 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.
 - 3. 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.
 - 4. 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.
 - 5. 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.

1.03 APPLICATIONS FOR PAYMENT

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

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- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the **<Insert day>** of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use form designated by Architect as form for Applications for Payment.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not 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.
- F. Transmittal: Submit signed and notarized original copies of each Application for Payment to Architect 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. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien in accordance with Owner's requirements and as follows:
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.

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2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. Sustainable design action plans, including preliminary project materials cost data.
 6. Schedule of unit prices.
 7. Submittal schedule (preliminary if not final).
 8. List of Contractor's staff assignments.
 9. List of Contractor's principal consultants.
 10. Copies of building permits.
 11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 12. Initial progress report.
 13. Report of preconstruction conference.
 14. Certificates of insurance and insurance policies.
 15. Performance and payment bonds.
 16. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
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.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 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

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SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01 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. Project meetings.

1.02 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.

1.03 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.

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1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in 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.

1.04 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 so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 1. Owner name.
 2. Owner's Project number.
 3. Name of Architect.
 4. Architect's Project number.
 5. Date.
 6. Name of Contractor.
 7. RFI number, numbered sequentially.
 8. RFI subject.
 9. Specification Section number and title and related paragraphs, as appropriate.
 10. Drawing number and detail references, as appropriate.
 11. Field dimensions and conditions, as appropriate.
 12. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 13. Contractor's signature.
 14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven 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.

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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 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 01 26 00 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within five days of receipt of the RFI response.
- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.
- 1.05 PROJECT MEETINGS
- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 - B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 1. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Critical work sequencing and long lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.

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- j. Submittal procedures.
 - k. Sustainable design requirements.
 - l. Preparation of Record Documents.
 - m. Use of the premises.
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for moisture and mold control.
 - s. Procedures for disruptions and shutdowns.
 - t. Construction waste management and recycling.
 - u. Parking availability.
 - v. Office, work, and storage areas.
 - w. Equipment deliveries and priorities.
 - x. First aid.
 - y. Security.
 - z. Progress cleaning.
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 of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at regular intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

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- 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.01 SUMMARY

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

1.02 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file.
 - 2. PDF file.
- B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at **[weekly]** **[monthly]** intervals.
- G. Material Location Reports: Submit at **[weekly]** **[monthly]** intervals.
- H. Site Condition Reports: Submit at time of discovery of differing conditions.
- I. Unusual Event Reports: Submit at time of unusual event.
- J. Qualification Data: For scheduling consultant.

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1.03 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 01 31 00 "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:

1.04 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, 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.

1.05 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial 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. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.
 - 3. Procurement Activities: Include procurement process activities for the following long lead-time 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.

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4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 5. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
- C. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- D. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate Final Completion percentage for each activity.
- E. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.
- 1.06 GANTT-CHART SCHEDULE REQUIREMENTS
- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for commencement of the Work.
1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.

1.02 DEFINITIONS

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

1.03 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 additional time for handling and reviewing submittals required by those corrections.

1.04 SUBMITTAL FORMATS

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

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11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. 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 on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.05 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
- 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.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

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1.06 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:

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- 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. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
- a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
- a. Number of Samples: Submit full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
- a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample set; remainder will be returned. Retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least **[three]** <Insert number> sets of paired units that show approximate limits of variations.
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

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- E. 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.
- F. 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.
- G. 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 substrate preparation and primers required.
 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.

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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.

1.07 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, 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.

1.08 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.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. 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 will not review submittals received from Contractor that do not have Contractor's review and approval.

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1.09 ARCHITECT'S REVIEW

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Related Sections:
 - 1. Section 01 43 39.16 "Integrated Exterior Mockups" for integrated exterior mockup assembly requirements.
- C. 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. 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.
 - 2. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.02 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 and Inspections: 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 particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

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- 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. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
 3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- 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. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- 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 and Inspections: 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 have the same meaning 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.

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1.03 DELEGATED-DESIGN SERVICES

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

1.04 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification 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.

1.05 ACTION SUBMITTALS

- A. Mockup Shop Drawings: For laboratory mockups.
 - 1. Include plans, sections, elevations, and details, 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.

1.06 INFORMATIONAL SUBMITTALS

- A. 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:

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

1.07 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. Statement on condition of substrates and their acceptability for installation of product.
 2. Statement that products at Project site comply with requirements.
 3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 5. Other required items indicated in individual Specification Sections.

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- 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. Statement that equipment complies with requirements.
 - 2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 3. Other required items indicated in individual Specification Sections.

1.08 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. 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 similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, 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.
- G. Testing and Inspecting 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 E329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

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- 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. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - d. 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, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups of size indicated.
 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
 5. Demonstrate the proposed range of aesthetic effects and workmanship.
 6. Obtain Architect'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.
 7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
 8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 10. Demolish and remove mockups when directed unless otherwise indicated.

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1.09 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. 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. 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.
 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. 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. Contractor-Engaged Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the 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.

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- 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 01 33 00 "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. **Contractor's Associated Requirements and 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. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 6. 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.
- 1.10 **SPECIAL TESTS AND INSPECTIONS**
- A. **Special Tests and Inspections:** Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 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.
- 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

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SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.01 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.

1.02 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.
 - 1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

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- 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.

1.03 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."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

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

1.02 USE CHARGES

- A. Installation, removal, 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.

1.03 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. Implementation and Termination Schedule: Within [15] <Insert number> days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- 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. 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 requirements for 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.

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- 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.
- G. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:
1. Methods used to meet the goals and requirements of the Owner.
 2. Concrete cutting method(s) to be used.
 3. Location of construction devices on the site.
 4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
 5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.
 6. Indicate locations of sensitive **[research] [patient] [equipment] <Insert item>** areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

1.04 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and the California Building Code.

1.05 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.

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PART 2 - PRODUCTS

2.01 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**] [, **with galvanized barbed-wire top strand**].
- B. Portable 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 and bottom rails. Provide [**concrete**] [**galvanized-steel**] bases for supporting posts.
- C. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.
- D. Wood Enclosure Fence: Plywood, [6 feet] [8 feet] high, framed with four 2-by-4-inch rails, with preservative-treated wood posts spaced not more than 8 feet apart.
- E. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.
- F. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches.
- G. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.02 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Field Offices: Owner will provide conditioned interior space for field offices [**for duration of Project**] [**upon completion of demolition and enclosure**].
- C. Common-Use Field Office: Of sufficient 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:

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

2.03 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 2. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of **[8]** <Insert number> at each return-air grille in system and remove at end of construction[.][**and clean HVAC system as required in Section 01 77 00 "Closeout Procedures."**]
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
- C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

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3.03 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- C. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- D. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.04 SUPPORT FACILITIES INSTALLATION

- A. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- B. Parking: Provide temporary offsite or use designated areas of Owner's existing parking areas, if authorized, for construction personnel.
- C. Storage and Staging: Provide temporary offsite area or use designated areas of Project site for storage and staging needs.
- D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- E. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

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- a. Provide temporary, directional signs for construction personnel and visitors.
- 3. Maintain and touch up signs, so they are legible at all times.

F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations.

3.05 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.

- 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

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

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

- 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 the course of Project.
- 4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

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

E. Tree and Plant Protection: 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.

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

G. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

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

- I. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
 - 1. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 - 2. Insulate partitions to control noise transmission to occupied areas.
 - 3. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 - 4. Protect air-handling equipment.
 - 5. Provide walk-off mats at each entrance through temporary partition.

- J. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.06 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed 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.

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- 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 the course of 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.

3.07 OPERATION, TERMINATION, AND REMOVAL

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

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- C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

END OF SECTION

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SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling and comparable products.

1.02 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. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, 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. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluation of Comparable Products: 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. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

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- 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. In the event that 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 or substitution request, if applicable.
 - D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
 - E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 33 00 "Submittal Procedures."
 - F. Substitution: Refer to Section 01 25 00 "Substitution Procedures" for definition and limitations on substitutions.
- 1.03 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.
- 1.04 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.
- 1.05 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 standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

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- 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 in the Project Manual, prepare a written document, using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.01 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 - 6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, 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."

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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] [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 that 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."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
 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] [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 that 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."
 - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
 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 may additionally 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 the phrase "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.

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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 a 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.

E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

1. Select products for which sustainable design documentation submittals are available from manufacturer.

2.02 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 the following 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.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. 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.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 01 33 00 "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Section 01 33 00 "Submittal Procedures."
2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: 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.

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- D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 1. Installation of the Work.
 2. Cutting and patching.
 3. Progress cleaning.
 4. Starting and adjusting.
 5. Protection of installed construction.

1.02 INFORMATIONAL SUBMITTALS

- A. Certified Surveys: Submit [**two**] <Insert number> copies signed by [**land surveyor**] [**professional engineer**].
- B. Certificates: Submit certificate signed by [**land surveyor**] [**professional engineer**], certifying that location and elevation of improvements comply with requirements.

1.03 CLOSEOUT SUBMITTALS

- A. Final Property Survey: Submit [**10**] <Insert number> copies showing the Work performed and record survey data.

1.04 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.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

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PART 2 - PRODUCTS

2.01 MATERIALS

- A. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
- B. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.01 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, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, 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:
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

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3.02 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect **[through Construction Manager]** in accordance with requirements in Section 01 31 00 "Project Management and Coordination."

3.03 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 and existing conditions. If discrepancies are discovered, notify Architect promptly.
- B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- C. 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.

3.04 FIELD ENGINEERING

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

3.05 INSTALLATION

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

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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, unless otherwise indicated on Drawings.
- 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 satisfactory results as judged by Architect. 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 of type expected for Project.
- 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: 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 with manufacturer.
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, as judged by Architect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.

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3.06 CUTTING AND PATCHING

3.07 PROGRESS CLEANING

- A. 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.
- 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: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

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- 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.

3.08 STARTING AND ADJUSTING

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

3.09 PROTECTION AND REPAIR 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. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION

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SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.01 SUMMARY

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

1.02 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.

1.03 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. Inform Architect of scheduled meeting. 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 affected by cutting and patching operations.
 - e. HVAC shutdown and sealing of air intakes.
 - 2. Coordinate work activities with Owner so Owner has adequate advance notice to place protective dust and water-leakage covers over sensitive equipment and furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below work area.
 - 3. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.04 INFORMATIONAL SUBMITTALS

- A. 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.

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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.

1.05 QUALITY ASSURANCE

- A. 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, or when encountering the need for cutting and patching of elements whose structural function is not known, 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.
 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.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Comply with requirements specified in other Sections.

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- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

- C. Fluid-Applied Flashing [**and Roofing**] Membrane: Flexible, PMMA-based resin combined with a thixotropic agent for use in combination with non-woven, needle-punched polyester fabric reinforcement to form a monolithic, reinforced flashing [**and roofing**] membrane.
 - 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
 - a. Kemper System; Kemperol AC Speed FR.
 - b. Siplast; Parapro.
 - c. Soprema; Alsan RS.

PART 3 - EXECUTION

3.01 CUTTING AND PATCHING

- A. 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 in accordance with 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 [**minimize**] [**prevent**] interruption to occupied areas.

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- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. 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 eliminate 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, corner to corner of wall and edge to edge of ceiling. 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.

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5. Roofing Membrane Assemblies: Patch roofing membrane penetrations and transitions with reinforced, liquid applied PMMA flashing membrane. Embed roofing granules to match existing roofing granule cap and flashing sheets.
6. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

END OF SECTION

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SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 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.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.03 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest-control inspection.

1.04 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.

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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. Label with manufacturer's name and model number.
 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 01 79 00 "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 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.
- 1.05 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 in accordance with Division 01 Section payment procedures."

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2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.06 LIST OF INCOMPLETE ITEMS

- 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, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. PDF Electronic File: Architect will return annotated file.

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

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PART 2 - PRODUCTS

2.01 MATERIALS

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

PART 3 - EXECUTION

3.01 FINAL CLEANING

- A. 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 of rubbish, waste material, litter, and other foreign substances.
 - b. 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.
 - c. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - d. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - e. Vacuum and mop concrete.
 - f. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - g. 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.
 - h. Remove labels that are not permanent.
 - i. Wipe surfaces of mechanical and electrical equipment[, **elevator equipment,**] and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

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- j. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- k. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- l. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
- m. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
- n. Clean strainers.
- o. Leave Project clean and ready for occupancy.

END OF SECTION

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SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Systems and equipment operation manuals.
 - 2. Systems and equipment maintenance manuals.
 - 3. Product maintenance manuals.

1.02 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 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. Initial Manual Submittal: Submit draft copy of each manual at least **[30] <Insert number>** days before commencing demonstration and training. Architect[**and Commissioning Authority**] will comment on whether general scope and content of manual are acceptable.
- D. 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.

1.03 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.

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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.

1.04 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 has 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:

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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.

1.05 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:

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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.

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1. Do not use original project record documents as part of maintenance manuals.

1.06 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

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SECTION 01 78 36 - WARRANTIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for warranties on products and systems.
- B. Related Sections:
 - 1. Section 01770 "Closeout Procedures" for submitting warranties.

1.02 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, system, and installation warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product or system and issued in the name of the Owner or endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner for a particular product or system and issued in the name of the Owner or endorsed by manufacturer to Owner.
 - a. Installation Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner for a particular product or system and issued in the name of the Owner or endorsed by installer to 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 in the Project Manual, prepare a written document, using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.

1.02 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up 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] [and] <Insert number> [paper copies]** of each submittal.
- 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] [and] <Insert number> [paper copies]** 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.

1.03 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.

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- 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 Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file.
 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

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1.04 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Note related Change Orders and Record Drawings where applicable.
- B. Format: Submit record specifications as annotated PDF electronic file .

1.05 MISCELLANEOUS RECORD SUBMITTALS

- A. Format: Submit miscellaneous record submittals as **[PDF electronic file] [paper copy] [scanned PDF electronic file(s) of marked-up miscellaneous record submittals]**.

1.06 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 (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 02 41 16 - DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Furnishing labor, materials and equipment necessary for demolition, dismantling, cutting and alterations as indicated, specified, or required for completion of the Work. Includes items such as the following:

1. Protection of existing improvements to remain.
2. Cleaning existing improvements to remain.
3. Disconnecting and capping utilities.
4. Removing debris, waste materials, and equipment.
5. Removal of items for performance of the Work.
6. Salvageable items to be retained by the Owner.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 01 1100 - Summary of Work.
3. Section 01 5000 - Construction Facilities and Temporary Controls.
4. Section 01 7329 - Cutting and Patching.
5. Section 01 7419 - Construction and Demolition Waste Management.
6. Division 22 -- Plumbing.
7. Division 23 -- HVAC.
8. Division 26 -- Electrical.

1.02 SUBMITTALS

A. Shop Drawings: Submit Shop Drawings indicating the extent of items and systems to be removed. Indicate items to be salvaged or items to be protected during demolition. Indicate locations of utility terminations and the extent of abandoned lines to be removed. Include details indicating methods and location of utility terminations.

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1.03 QUALITY ASSURANCE

- A. Perform the Work of this section by workers skilled in the demolition of buildings and structures. Perform the Work of this section under direct superintendence at all times.
- B. Prior to commencement of Work, schedule a walkthrough with the OAR, to confirm Owner property items have been removed from scheduled Work areas. Identify and mark remaining property items and schedule their removal.
- C. Coordinate demolition for the correct sequence, limits, and methods. Schedule demolition Work to create least possible inconvenience to the public and facility operations.
- D. Related Standard: ANSI/ASSE A10.6.

1.04 PROJECT CONDITIONS

- A. Drawings may not indicate in detail all demolition Work to be performed. Examine existing conditions to determine the full extent of required demolition.
- B. Repair damage to existing improvements or damage due to excessive demolition.
- C. Provide all measures to avoid excessive damage from inadequate or improper means and methods, improper shoring, bracing or support.
- D. If conditions are encountered that varies from those indicated, promptly notify the Architect for clarification before proceeding.

PART 2 - PRODUCTS

2.01 HANDLING OF MATERIALS

- A. Items scheduled for salvage by the Owner shall be delivered to a location designated by the OAR. Items shall be cleaned, packaged and labeled for storage.
- B. Items scheduled for reuse shall be stored on the Project site and protected from damage, theft and other deleterious conditions.

PART 3 - EXECUTION

3.01 GENERAL

- A. Protection:
 - 1. Do not commence demolition until safety partitions, barricades, warning signs and other forms of protection are installed. Refer to Section 01 5000 - Construction Facilities and Temporary Controls.

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2. Provide safeguards, including warning signs, lights and barricades, for protection of workers, occupants, and the public.

B. If safety of existing construction appears to be endangered, take immediate measures to correct such conditions; cease operations and immediately notify the OAR.

3.02 DEMOLITION

A. Do not throw or drop materials. Furnish ramps or chutes as required by the Work.

B. Remove existing construction only to extent necessary for proper installation of Work and interfacing with existing construction. Cut back finished surfaces to straight, plumb or level lines as required for a smooth transition.

C. Where openings are cut oversize or in improper locations, replace or repair to required condition.

3.03 CUTTING EXISTING CONCRETE

A. Cutting of existing concrete shall be performed by skilled workers familiar with the requirements and space necessary for placing concrete. Perform concrete cutting with concrete cutting wheels and hand chisels. Do not damage concrete intended to remain.

B. Extent of cutting of structural concrete shall be as indicated on Drawings. Cutting of non-structural concrete shall be as indicated on Drawings or as reviewed by the Architect or structural engineer. Replace concrete demolished in excess of amounts indicated.

C. Prior to cutting or coring concrete, determine locations of hidden utilities or other existing improvements and provide necessary measures to protect them from damage.

3.04 REMOVAL OF EXISTING PLUMBING AND ELECTRICAL EQUIPMENT AND SERVICES

A. Remove existing plumbing and electrical equipment fixtures and services not indicated for reuse and not necessary for completion of the Work. Remove abandoned lines and cap unused portions of existing lines.

3.05 REMOVAL OF OTHER MATERIALS

C. Roofing: Remove as required, including accessory components such as insulation and flashings. At penetrations through existing roofing, trim cut edges back to sound roofing with openings restricted to the minimum size necessary to receive Work.

D. Sheet Metal: Remove back to joint, lap, or connection. Secure loose and unfastened ends or edges and provide a watertight condition. Re-seal as required.

F. Modular materials such as acoustical ceiling panels, resilient tile, or ceramic tile: Remove to a natural joint without leaving damaged or defective Work where joining

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new Work. After flooring removal, clean substrates to remove setting materials and adhesives.

- G. Gypsum Board: Remove to a panel joint line on a stud or support line.
- H. Plaster: Saw cut plaster on straight lines, leaving a minimum 2-inch width of firmly attached metal lath for installing new lath and plaster.
- I. Remove existing improvements not specifically indicated or required but necessary to perform Work. Cut to clean lines, allowing for installation of Work.

3.06 PATCHING

- A. Patch or repair materials to remain when damaged by the performance of the Work of this section. Finish material and appearance of patch and/or repair Work shall match existing.

3.07 CLEANING

- A. Clean existing materials to remain with appropriate tools and equipment.
- B. Protect existing improvements during cleaning operations.
- C. Debris shall be dampened by fog water spray prior to transporting by truck.
- D. Debris pick-up area shall be kept broom-clean and shall be washed daily with clean water.
- E. Remove waste and debris, other than items to be salvaged. Turn over salvaged items to Owner, or store and protect for reuse where required. Continuously clean up and remove items as demolition Work progresses.
- F. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

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SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 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.

1.02 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 Owner ready for reuse.
- 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.

1.03 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.04 PREINSTALLATION 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.

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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.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property for dust control and for noise control. Indicate proposed locations and construction of barriers.
- D. Schedule of Selective Demolition Activities: Indicate the following:
 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Use of elevator and stairs.
 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 01 32 33 "Photographic Documentation." Submit before Work begins.
- F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.06 CLOSEOUT SUBMITTALS

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

1.07 FIELD CONDITIONS

- A. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.

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3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

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

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

1. Maintain fire-protection facilities in service during selective demolition operations.

1.08 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.01 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: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.02 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. 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.

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3. 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.
 - 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.

3.03 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.
- 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.

3.04 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:

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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 **<Insert number>** 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.

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- 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.

3.05 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
 - 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.
 - 4. Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.06 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

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SECTION 03 35 03 - CONCRETE SLAB FINISHING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Concrete finish requirements for unformed horizontal concrete surfaces. This section supplements requirements of Division 03 Section "Cast-In-Place Concrete."
- B. Related Sections:
 - 1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.

1.02 ACTION SUBMITTALS

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

1.03 QUALITY ASSURANCE

- A. Standards: Comply with the following documents, except where requirements of the contract documents are more stringent:
 - 1. ACI 301.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

See Evaluations for discussion on slip resistance and coefficient of friction values. If retaining this article, verify that tile products selected for flooring comply with requirements.

- A. Coefficient of Friction: For penetrating sealers installed on walkway surfaces, provide products with the following values as determined by testing identical products:
 - 1. Level Surfaces: SCOF of not less than 0.86 dry, 0.67 wet in accordance with ASTM C1028.

2.02 CONCRETE SLAB SEALER

- A. Concrete Slab Sealer: Liquid chemical hardener; enhanced silicate or silicate type.
 - 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. Curecrete Chemical; Ashford Formula.
 - b. Dayton Superior; Sure Hard Densifier J17.

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- c. Laticrete; L&M Lion Hard.

2.03 REPAIR MATERIALS

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

PART 3 - EXECUTION

3.01 REPAIRING SLAB SURFACES

- A. Repairing Unformed Surfaces:
 - 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.

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

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3.02 SEALED CONCRETE FLOORS

A. Concrete Slab Sealer:

1. Apply sealer/finish following manufacturer's printed application instructions; apply single saturation coat.
2. Remove surplus sealer/hardener and rinse according to manufacturer's instructions.
3. Burnishing: Prior to substantial completion, apply light second coat of chemical sealer-hardener material and polish using mild abrasives or brushes in accordance with sealer/hardener manufacturer's recommendations. Buff to even satin sheen.
4. Location: At all interior, exposed slabs subject to pedestrian traffic, unless indicated otherwise.

END OF SECTION

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SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Miscellaneous metal items indicated and specified, or otherwise necessary for completion of the work. Work of this section includes, but is not limited to, the following:
 - 1. Ferrous and non-ferrous metalwork detailed on the drawings as a component part of other assemblies, but not specified elsewhere.
 - 2. Steel base.

1.02 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of 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.

1.03 COORDINATION

- A. 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.

1.04 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.01 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 A36/A36M.

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2.02 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Division 09 "Painting" Sections.

2.03 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. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- H. 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.

2.04 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.

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- 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. Prime and paint miscellaneous steel trim with coating system specified in Section 09 91 00 - Painting.

2.05 GENERAL FINISH REQUIREMENTS

- 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.

2.06 STEEL AND IRON FINISHES

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

PART 3 - EXECUTION

3.01 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. 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.

END OF SECTION

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SECTION 05 53 13 - BAR GRATINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Metal bar gratings.
 - 2. Grating frames and supports.

1.02 ACTION SUBMITTALS

- A. Product Data: For each product specified.
- B. Shop Drawings:
 - 1. Include plans, sections, and attachment details.

1.03 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: 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.

1.04 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.01 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. Grating Pacific, Inc.
 - 2. McNichols.
 - 3. Nucor.
 - 4. Ohio Gratings, Inc.

2.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Gratings to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Walkways and Elevated Platforms Other Than Exits: Uniform load of 60 lbf/sq. ft..
 - 2. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft..
 - 3. Limit deflection to L/360 or 1/4 inch, whichever is less.

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2.03 METAL BAR GRATINGS

- A. Metal Bar Grating Standards: Comply with **[NAAMM MBG 531]** **[and]** **[NAAMM MBG 532]**.
- B. Welded Steel Grating[**MBG-#**]:
1. Bearing Bar Spacing: [7/16 or 1/2 inch] [11/16 inch] [15/16 inch] [1-3/16 inches] [1-3/8 inches] [1-7/8 inches] [2-3/8 inches] **<Insert dimension(s)>** o.c.
 2. Bearing Bar Depth: [3/4 inch] [1 inch] [1-1/4 inches] [1-1/2 inches] [1-3/4 inches] [2 inches] [2-1/4 inches] [2-1/2 inches] [3 inches] [3-1/2 inches] [4 inches] [4-1/2 inches] [5 inches] **[As required to comply with structural performance requirements]**.
 3. Bearing Bar Thickness: [1/8 inch] [3/16 inch] [1/4 inch] [3/8 inch] **[As required to comply with structural performance requirements]**.
 4. Crossbar Spacing: [2 inches] [4 inches] o.c.
 5. Grating Mark W-11-4 (1 x 3/16) STEEL: 1-by-3/16-inch bearing bars at 11/16 inch o.c., and crossbars at 4 inches o.c.
 6. Grating Mark W-15-4 (1 x 1/8) STEEL: 1-by-1/8-inch bearing bars at 15/16 inch o.c., and crossbars at 4 inches o.c.
 7. Grating Mark W-19-4 (1-1/4 x 3/16) STEEL: 1-1/4-by-3/16-inch bearing bars at 1-3/16 inches o.c., and crossbars at 4 inches o.c.
 8. Grating Mark W-19-4 (1-1/2 x 3/16) STEEL: 1-1/2-by-3/16-inch bearing bars at 1-3/16 inches o.c., and crossbars at 4 inches o.c.
 9. Grating Mark W-19-4 (2 x 1/4) STEEL: 2-by-1/4-inch bearing bars at 1-3/16 inches o.c., and crossbars at 4 inches o.c.
 10. Grating Mark W-30-4 (5 x 3/8) STEEL: 5-by-3/8-inch bearing bars at 1-7/8 inches o.c., and crossbars at 4 inches o.c.
 11. Grating Mark: As indicated.
 12. Traffic Surface: **[Plain]** **[Serrated]** **[Knurled]** **[Applied abrasive finish consisting of aluminum-oxide aggregate in an epoxy-resin adhesive]** **[As indicated]**.
 13. Steel Finish: **[Shop primed]** **[Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface]**.

2.04 GRATING FRAMES AND SUPPORTS

- A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
1. Unless otherwise indicated, fabricate from same basic metal as gratings.
 2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.

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- B. Galvanize steel frames and supports in the following locations:
 - 1. Exterior.

2.05 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563, and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563, and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- D. Post-Installed Anchors: Torque-controlled expansion 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 in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.06 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Bars for Bar Gratings: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018/A1018M.
- C. Wire Rod for Bar Grating Crossbars: ASTM A510/A510M.

2.07 FABRICATION

- A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. 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.

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- B. Cut, drill, and punch material 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 from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
 - D. Fit exposed connections accurately together to form hairline joints.
 - E. Welding: Comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
 - 1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.
 - 2. Fabricate toeplates for attaching in the field.
 - 3. Toeplate Height: 4 inches unless otherwise indicated.
 - G. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.
 - 1. Provide no fewer than four saddle clips for each grating section containing rectangular bearing bars 3/16 inch or less in thickness and spaced 15/16 inch or more o.c., with each clip designed and fabricated to fit over two bearing bars.
 - 2. Provide no fewer than four weld lugs for each grating section containing rectangular bearing bars 3/16 inch or less in thickness and spaced less than 15/16 inch o.c., with each lug shop welded to three or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.
 - 3. Furnish threaded bolts with nuts and washers for securing grating to supports.
 - H. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
 - 1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
 - I. Do not notch bearing bars at supports to maintain elevation.
- 2.08 STEEL FINISHES
- A. Finish gratings, frames, and supports after assembly.

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- B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

3.02 INSTALLATION OF METAL BAR GRATINGS

- A. Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

END OF SECTION

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SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Rooftop equipment bases and support curbs.
3. Wood blocking[, **cants,**] and nailers.
4. Wood furring[**and grounds**].
5. Wood sleepers.
6. Plywood backing panels.

B. Related Sections:

1. Division 01 sustainable design requirements Section(s) for supplementary sustainable design criteria.
2. Section 06 16 00 "Sheathing" for sheathing, subflooring, and underlayment.
3. Section 06 17 53 "Shop-Fabricated Wood Trusses" for wood trusses made from dimension lumber.

1.02 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

1.03 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 D5664.
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.

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1.04 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
1. Documentation for composite wood products, indicating compliance with emissions testing or certification.
 2. Chain-of-Custody Certificates: For certified wood products.
 3. Chain-of-Custody Qualification Data: For manufacturer and vendor.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.06 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
1. Composite Wood Products:
 - a. Formaldehyde emissions testing or certification.
 2. Wood and Wood Products: **[Architect anticipates that compliance]** **[Compliance]** with sustainable design criteria for material sourcing will require the following:
 - a. **[Lumber] [and] [Plywood]**: Certified wood.

2.02 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, **[mark grade stamp on end or back of each piece] [or] [omit grade stamp and provide certificates of grade compliance issued by grading agency]**.

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3. Dress lumber, S4S, unless otherwise indicated.

- B. Maximum Moisture Content of Lumber: **[15 percent] [19 percent] [15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness] [15 percent for 2-inch nominal thickness or less; no limit for more than 2-inch nominal thickness] [19 percent for 2-inch nominal thickness or less; no limit for more than 2-inch nominal thickness]** unless otherwise indicated.

2.03 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2[**for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground**].

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.[**Do not use inorganic boron (SBX) for sill plates.**]
2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

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 inspection agency]**.

- D. Application: Treat **[all miscellaneous carpentry unless otherwise indicated.] [items indicated on Drawings, 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. Wood sills, sleepers, blocking, **[furring,] [stripping,]** and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

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2.04 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 E84, 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 D2898. 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 D3201 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 D5664, and design value adjustment factors shall be calculated according to ASTM D6841. **[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 a maximum moisture content of 19 percent. **[Kiln-dry plywood after treatment to a 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 inspection 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 **[all miscellaneous carpentry unless otherwise indicated.] [items indicated on Drawings, and the following:]**
1. Framing for raised platforms.
 2. Concealed blocking.
 3. Roof framing and blocking.

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4. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
5. Plywood backing panels.

2.05 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: [**Construction or No. 2**] [**Construction, Stud, or No. 3**] [**Standard, Stud, or No. 3**] grade of [**any species.**] [**any of the following species:**] [**the following species:**]
1. Hem-fir (north); NLGA.
 2. Mixed southern pine or southern pine; SPIB.
 3. Spruce-pine-fir; NLGA.
 4. Hem-fir; WCLIB or WWPA.
 5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 6. Northern species; NLGA.
 7. Eastern softwoods; NeLMA.
 8. Western woods; WCLIB or WWPA.
- B. Other Framing: [**No. 2**] [**Construction or No. 2**] [**Construction, Stud, or No. 3**] grade of [**any of the following**] [**the following**] species:
1. Hem-fir (north); NLGA.
 2. Southern pine; SPIB.
 3. Douglas fir-larch; WCLIB or WWPA.
 4. Southern pine or mixed southern pine; SPIB.
 5. Spruce-pine-fir; NLGA.
 6. Douglas fir-south; WWPA.
 7. Hem-fir; WCLIB or WWPA.
 8. Douglas fir-larch (north); NLGA.
 9. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

2.06 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.
 7. Utility shelving.
- B. Dimension Lumber Items: [**Construction or No. 2**] [**Standard, Stud, or No. 3**] grade lumber of [**any species.**] [**any of the following species:**] [**the following species:**]
1. Hem-fir (north); NLGA.
 2. Mixed southern pine or southern pine; SPIB.
 3. Spruce-pine-fir; NLGA.

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4. Hem-fir; WCLIB or WWPA.
 5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 6. Western woods; WCLIB or WWPA.
 7. Northern species; NLGA.
 8. Eastern softwoods; NeLMA.
- C. Utility Shelving: Lumber with [15] [19] percent maximum moisture content of **[any of the following] [the following]** species and grades:
1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; **[Premium or No. 2 Common (Sterling)] [Standard or No. 3 Common]** grade; NeLMA, NLGA, WCLIB, or WWPA.
 2. Mixed southern pine or southern pine **[No. 1] [No. 2]** grade; SPIB.
 3. Hem-fir or hem-fir (north), **[Select Merchantable or No. 1 Common] [Construction or No. 2 Common]** grade; NLGA, WCLIB, or WWPA.
 4. Spruce-pine-fir (south) or spruce-pine-fir, **[Select Merchantable or No. 1 Common] [Construction or No. 2 Common]** grade; NeLMA, NLGA, WCLIB, or WWPA.
- D. Concealed Boards: [15] [19] percent maximum moisture content of **[any of the following] [the following]** species and grades:
1. Mixed southern pine or southern pine, **[No. 2] [No. 3]** grade; SPIB.
 2. Hem-fir or hem-fir (north), **[Construction or No. 2 Common] [Standard or No. 3 Common]** grade; NLGA, WCLIB, or WWPA.
 3. Spruce-pine-fir (south) or spruce-pine-fir, **[Construction or No. 2 Common] [Standard or No. 3 Common]** grade; NeLMA, NLGA, WCLIB, or WWPA.
 4. Eastern softwoods, **[No. 2] [No. 3]** Common grade; NELMA.
 5. Northern species, **[No. 2] [No. 3]** Common grade; NLGA.
 6. Western woods, **[Construction or No. 2 Common] [Standard or No. 3 Common]** grade; WCLIB or WWPA.
- E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.
- 2.07 PLYWOOD BACKING PANELS
- A. Equipment Backing Panels: Plywood, DOC PS 1, **[Exterior, A-C] [Exterior, C-C Plugged] [Exposure 1, C-D Plugged]**, **[fire-retardant treated,]** in thickness indicated or, if not indicated, not less than [1/2-inch] [3/4-inch] nominal thickness.

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2.08 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners[**with hot-dip zinc coating complying with ASTM A153/A153M**] [of Type 304 stainless steel].
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Screws for Fastening to Metal Framing: [**ASTM C1002**] [**ASTM C954**], length as recommended by screw manufacturer for material being fastened.
- D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. 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 B633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate[**furring,**] nailers, blocking, [**grounds,**] and similar supports to comply with requirements for attaching other construction.
- C. 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.**]
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Do not splice structural members between supports unless otherwise indicated.

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- F. 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.

- G. 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 20 feet o.c.

- H. 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.

- I. Comply with AWPA 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.

- J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

- K. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
 - 3. ICC-ES evaluation report for fastener.

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- L. 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.

3.02 INSTALLATION OF WOOD BLOCKING AND NAILER

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

3.03 INSTALLATION OF WOOD FURRING

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring [**horizontally**] [**and**] [**vertically**] at [24 inches] [**600 mm**] o.c.
- C. Furring to Receive [**Gypsum Board**] [**Plaster Lath**]: Install 1-by-2-inch nominal- size furring vertically at [16 inches] [**400 mm**] o.c.

3.04 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 miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

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SECTION 07 01 50.19 - PREPARATION FOR REROOFING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Re-cover preparation of entire roof area.
 2. Removal of flashings and counterflashings.

1.02 PREINSTALLATION MEETINGS

- A. Preliminary Roofing Conference: Before starting removal Work, conduct conference at Project site.
1. Meet with Owner, Architect, 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.

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1.03 ACTION SUBMITTALS

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

1.04 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.

1.05 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.

1.06 FIELD CONDITIONS

- A. Existing Roofing System: Built-up asphalt or modified bituminous roofing.
- B. Owner will occupy portions of building immediately below reroofing area.
1. Conduct reroofing so Owner's operations are not disrupted.
 2. Provide Owner with not less than 72 hours' written notice of activities that may affect Owner's operations.
 3. Coordinate work activities daily with Owner so Owner has adequate advance notice to place protective dust and water-leakage covers over sensitive equipment and furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below work area.
 4. Before working over structurally impaired areas of deck, notify Owner to evacuate occupants from below affected area.
 - a. Verify that occupants below work area have been evacuated before proceeding with work over impaired deck area.

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- C. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
- D. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
- E. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.
- F. Limit construction loads on existing roof areas to remain, and existing roof areas scheduled to be reroofed to <Insert load> for rooftop equipment wheel loads and <Insert load> for uniformly distributed loads.
- G. 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.
- H. Hazardous Materials: A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except according to procedures specified elsewhere in the Contract Documents.
 - 3. Coordinate reroofing preparation with hazardous material remediation to prevent water from entering existing roofing system or building.

PART 2 - PRODUCTS

2.01 INFILL AND REPLACEMENT MATERIALS

- A. Wood blocking, curbs, and nailers are specified in Section 06 10 53 Miscellaneous Rough Carpentry."
- B. Plywood roof sheathing is specified in a Division 06 Section sheathing.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Seal or isolate windows that may be exposed to airborne substances created in removal of existing materials.

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- B. Shut off rooftop utilities and service piping before beginning the Work.
- C. Test existing roof drains to verify that they are not blocked or restricted.
 - 1. Immediately notify Architect of any blockages or restrictions.
- D. 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.
- E. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.
- F. 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.

3.02 ROOF RE-COVER PREPARATION

- A. Remove blisters, ridges, buckles, and other substrate irregularities from existing roofing that inhibit new cover boards from conforming to substrate.
 - 1. Broom clean existing substrate.

3.03 BASE FLASHING REMOVAL

- A. Remove existing base flashings.
- B. Do not damage metal counterflashings that are to remain.
 - 1. Replace metal counterflashings damaged during removal with counterflashings of same metal, weight or thickness, and finish as existing.

3.04 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.

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3.05 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

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SECTION 07 54 19 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Polyvinyl-chloride roofing membrane assembly including the following:
 - 1. Adhered polyvinyl chloride (PVC) roofing system.
 - 2. Cover board.

- B. Related Sections:
 - 1. Division 06 Sections for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
 - 2. Division 06 Sections for wood-based, structural-use roof deck panels.
 - 3. 07 01 50.19 - PREPARATION FOR REROOFING.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Roofing Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Examine substrate conditions and finishes for compliance with requirements, including flatness and fastening.
 - 5. Review structural loading limitations of roof deck during and after roofing.
 - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
 - 7. Review governing regulations and requirements for insurance and certificates if applicable.
 - 8. Review temporary protection requirements for roofing system during and after installation.
 - 9. Review roof observation and repair procedures after roofing installation.

1.03 ACTION SUBMITTALS

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

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- B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
 - 1. Flashings and membrane termination details.
 - 2. Flashing details at penetrations.

1.04 INFORMATIONAL SUBMITTALS

- A. Sustainable Design Submittals:
 - 1. Documentation for adhesives, indicating VOC content.
- B. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.
- C. Field Test Reports:
 - 1. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.
- D. Field quality-control reports.
- E. Sample Warranties: For manufacturer's special warranties.

1.05 CLOSEOUT SUBMITTALS

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

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

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1.08 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.09 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes roof membrane, base flashings, cover boards, and other components of roofing system.
 - 2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SUSTAINABLE DESIGN CRITERIA

- A. Sustainable Design Criteria: Comply with indicated criteria for the following product categories:
 - 1. Adhesives:
 - a. VOC content limits for field applications.
 - 2. Sealants:
 - a. VOC content limits for field applications.
 - 3. Roofing: Solar reflectance performance as follows:

2.02 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.
 - 1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
 - 2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- C. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in SPRI's Directory of Roof Assemblies for roof assembly identical for that specified for this Project.

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1. Wind Uplift Load Capacity: 90 psf.

2.03 POLYVINYL CHLORIDE (PVC) ROOFING

- A. PVC Sheet: ASTM D4434/D4434M, Type II, glass-fiber reinforced, felt backed.
 - a.
 2. Basis-of-Design Product: Subject to compliance with requirements, provide Sika Sarnafil G410 Feltbackor comparable product by one of the following:
 - a. Carlisle.
 - b. Firestone.
 - c. Seaman Corp.
 - d.
 3. Thickness: 72 mils minimum.
 4. Exposed Face Color: As selected by Architect.
- B. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.

2.04 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: Manufacturer's standard unreinforced PVC sheet flashing, 55 mils thick, minimum, of same color as PVC sheet.
 1. Exposed Face Color: **[Copper brown] [Evergreen] [Lead gray] [Patina green] <Insert color>**.
- C. Liquid-Applied Flashing System: Manufacturer's recommended multicomponent, reinforced, UV stabilized poly methyl-methacrylate resin flashing compatible with waterproofing membrane and suitable for exposed conditions.
 1. Primer: As recommended by manufacturer.
 2. Reinforcing Fabric: Polyester.
- D. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- E. Bonding Adhesive: Manufacturer's standard.
- F. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

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- H. Miscellaneous Accessories: Provide preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.
 - 1. Compressive Strength: [20 psi] [25 psi].

2.05 COVER BOARD

- A. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.
 - 1. Thickness: 1/4 inch.
 - 2. Surface Finish: As recommended by manufacturer.

2.06 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer.
 - 1. Size: Approximately 36 by 60 inches.
 - 2. Color: Contrasting with roof membrane.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Perform fastener-pullout tests according to roof system manufacturer's written instructions.
 - 1. Submit test result within 24 hours after performing tests.

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- a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.03 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions, SPRI's Directory of Roof Assemblies listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

3.04 INSTALLATION OF COVER BOARD

- A. Install cover board with long joints in continuous straight lines, with end joints staggered not less than 24 inches in adjacent rows.
 - 1. Tightly butt substrate boards together.
 - 2. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - 3. Fasten cover board to existing roof deck through existing roof membrane assembly according to manufacturer's recommendations, SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity, and FM Global Property Loss Prevention Data Sheet 1-29.
 - 4. Loosely lay substrate board over roof deck.

3.05 INSTALLATION OF ADHERED ROOF MEMBRANE

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- F. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.

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- G. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.
- H. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- I. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings, to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
 - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- J. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.06 INSTALLATION OF BASE FLASHING

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.07 INSTALLATION OF LIQUID-APPLIED FLASHING

- A. Liquid-Applied Flashing: Install liquid-applied flashing at locations indicated and where conditions are not favorable to install sheet flashing, in accordance with manufacturer's recommendations.

3.08 INSTALLATION OF WALKWAYS

- A. Flexible Walkways:
 - 1. Install flexible walkways at locations indicated on drawings.
 - 2. Provide 6-inch clearance between adjoining pads.
 - 3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

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3.09 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
- B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.10 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

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SECTION 07 60 00 - FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Manufactured Products:
 - a. Manufactured reglets and counterflashing.
 - 2. Formed Products:
 - a. Formed sheet metal fabrications.

- B. Related Sections:
 - 1. Section 07 65 00 - Flexible Flashing: For flexible flashing membranes.

1.02 ACTION SUBMITTALS

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

- B. Shop Drawings: Show installation layouts of flashing and sheet metal, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
 - 1. Include details for forming, joining, supporting, and securing flashing and sheet metal, including pattern of seams, termination points, fixed points, expansion joints, expansion-joint covers, edge conditions, special conditions, and connections to adjoining work.
 - 2. Include identification of material, thickness, weight, and finish for each item.

- C. Samples: For each exposed product and for each finish specified.

1.03 INFORMATIONAL SUBMITTALS

- A. Maintenance data.

1.04 QUALITY ASSURANCE

- A. Flashing and Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

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

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PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Flexible Flashing Performance, General: Flexible flashing seals with adjacent construction shall be capable of performing as a continuous air and water barrier. Flexible flashing shall be capable of accommodating substrate movement, construction material changes, penetrations, and transitions without deterioration, water penetration under pressure differential, and air leakage exceeding specified limits.
- B. Self-Adhering Flexible Flashing Performance: Self-adhering flexible flashing shall meet minimum performance requirements when tested according to AAMA 711.

2.02 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; 2B (bright, cold rolled) finish.
- C. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
 - 2. Exposed Finish: Field painted.
 - a. Color: As indicated on drawings.
 - b. Where field painting after installation is required, pretreat metal to accept primer and topcoats required in accordance with Division 09 painting sections.

2.03 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete flashing and sheet metal installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.

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- 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 Stainless-Steel Sheet: Series 300 stainless steel.
 - 4. Fasteners for Metallic-Coated Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.
- C. Solder:
- 1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in flashing and sheet metal and remain watertight.
- F. Butyl Sealant: ASTM C 1311, 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 complying with ASTM D 1187.
- 2.04 REGLETS
- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.
 - 1. Material: Galvanized steel, 0.022 inch thick.
 - 2. Finish: Mill.
- 2.05 FABRICATION, GENERAL
- A. General: Custom fabricate flashing and sheet metal to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
 - 1. Obtain field measurements for accurate fit before shop fabrication.

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2. Form flashing and sheet metal without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- C. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Seams, Stainless Steel: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- F. Seams, Painted and Coated Metals: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

2.06 SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.
1. Expansion Joints: Lap type.
 2. Accessories: Wire ball downspout strainer.
 3. Gutters with Girth up to 15 Inches: Fabricate from the following materials, as indicated on drawings:
 - a. Aluminum: 0.032 inch thick, minimum.
 - b. Galvanized Steel: 0.022 inch thick.
 4. Gutters with Girth 16 to 20 Inches: Fabricate from the following materials, as indicated on drawings:
 - a. Aluminum: 0.040 inch thick, minimum.
 - b. Galvanized Steel: 0.028 inch thick.
- B. Parapet Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch- wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:
1. Stainless Steel: 0.019 inch thick, minimum.

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- C. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape indicated complete with outlet tubes and built-in overflows. Fabricate from the following materials, as indicated on drawings:
 - 1. Galvanized Steel: 0.028 inch thick.

- D. Copings: Fabricate in minimum 96-inch- long, but not exceeding 10-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight. Fabricate from the following materials:
 - 1. Joint Style: Butt, with 12-inch- wide, concealed backup plate.
 - 2. Fabricate from the following material, as indicated on drawings:
 - a. Galvanized Steel: 0.040 inch thick.

- E. Counterflashing: Fabricate from the following materials:
 - 1. Galvanized Steel: 0.022 inch thick.

- F. 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.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. General: Anchor flashing and sheet metal and other components of the Work securely in place, with provisions for thermal and structural movement so that completed flashing and sheet metal shall not rattle, leak, or loosen, and shall remain watertight. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete flashing and sheet metal system.
 - 1. Install flashing and sheet metal true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install flashing and sheet metal to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 - 4. Install exposed flashing and sheet metal without excessive oil canning, buckling, and tool marks.
 - 5. Install sealant tape where indicated.
 - 6. Torch cutting of flashing and sheet metal is not permitted.

- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

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1. Coat back side of stainless-steel flashing and sheet metal with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- D. Seal joints as shown and as required for watertight construction.
- E. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
 1. Do not solder metallic-coated steel and aluminum sheet.
 2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 3. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.02 SHEET METAL FLASHING INSTALLATION

- A. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
 1. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
- B. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
- C. Conductor Heads: Anchor securely to wall with elevation of conductor head rim 1 inch below scupper discharge.
- D. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints a minimum of 4 inches in direction of water flow.
- E. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.

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- F. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant.
- G. Reglets: Installation of reglets is specified in [Division 03 Section "Cast-in-Place Concrete] [Division 04 Section "Unit Masonry]."
- H. Opening Flashings in Frame Construction: Install continuous head, sill,[jamb,] and similar flashings to extend [4 inches] <Insert extension> beyond wall openings.

3.03 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as flashing and sheet metal are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION

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SECTION 07 65 00 - FLEXIBLE FLASHING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Self-adhering flexible flashing.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation layouts of flashing, including plans, elevations, expansion-joint locations, and keyed details.
 - 1. Include details for forming, joining, supporting, and securing flashing, including termination points, expansion joints, edge conditions, special conditions, and connections to adjoining work.
 - 2. Include identification of material and thickness for each item.
- C. Samples: For each exposed product and for each finish specified.

1.03 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of flexible flashing product, for tests performed by a qualified testing agency.
- B. Maintenance data.

1.04 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockups of typical exterior assemblies incorporating supporting construction, wall construction, cladding, window, glazed framing assemblies, door frames and sills, anchors, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of flexible flashings, and sealing of laps, gaps, terminations, and penetrations including, attachments, and accessories.
 - a. Coordinate construction of mockups to permit inspection and testing of flexible flashing before concealment with external components.
 - b. If Architect determines mockups do not comply with requirements, reconstruct mockups until approved.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

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3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Flexible Flashing Performance, General: Flexible flashing seals with adjacent construction shall be capable of performing as a continuous air and water barrier. Flexible flashing shall be capable of accommodating substrate movement, construction material changes, penetrations, and transitions without deterioration, water penetration under pressure differential, and air leakage exceeding specified limits.
- B. Self-Adhering Flexible Flashing Performance: Self-adhering flexible flashing shall meet minimum performance requirements when tested according to AAMA 711.

2.02 SELF-ADHERING FLEXIBLE FLASHING

- A. Self-Adhering Flexible Flashing: Cold-applied flashing tape, a minimum of 30 mils thick, consisting of a polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing, in factory cut widths.
 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. GCP Applied Technologies; Perm-A-Barrier Wall Flashing.
 - b. Henry; Blueskin TWF.
 - c. W.R. Meadows; Air-Shield Thru-Wall Flashing.
 2. Locations: Transition flashing at sheathing, metal flashings, and other locations indicated.
- B. High Temperature Self-Adhering Membrane Flashing: Cold-applied flashing tape, a minimum of 30 mils thick, consisting of a polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing, in factory cut widths.
 1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Protecto Wrap: Sill Pan Flash Butyl.
 - b. Henry; FortiFlash Butyl Waterproof Flashing Membrane.
 - c. GCP; Grace Ultra.
 2. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.
 3. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.
 4. Locations:
 - a. Beneath metal copings.
 - b. Other locations indicated.
- C. Liquid Mastic: Liquid mastic recommended by flashing manufacturer.

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2.03 MISCELLANEOUS MATERIALS

- A. General: Provide materials required for complete flashing installation as recommended by manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. General: Install flashing securely in place, with provisions for thermal and structural movement so that completed flashing shall not leak and shall remain watertight.
1. Install flashing and sheet metal true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install flashing to fit substrates and conform to geometry of area receiving flashing resulting in watertight performance.

3.02 SELF-ADHERING FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
1. Clean, prepare, prime, and treat substrates according to manufacturer's written instructions.
 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. Apply in a shingled manner to shed water without interception by any exposed sheet edges.
 4. Roll firmly to enhance adhesion to substrates.

3.03 FIELD QUALITY CONTROL

- A. Inspections: Flexible flashing materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
1. Continuity of flexible flashing has been achieved throughout the building envelope with no gaps or holes.
 2. Liquid-applied flexible flashing thickness.
 3. Continuous structural support of self-adhering flexible flashing has been provided.
 4. Maximum exposure time of materials to UV deterioration has not been exceeded.
 5. Surfaces have been primed, if applicable.
 6. Self-adhering flexible flashing laps have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 7. Termination mastic has been applied on cut edges of self-adhering flexible flashing.
 8. Self-adhering flexible flashing has been firmly adhered to substrates.
 9. Compatible materials have been used.

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10. Transitions at changes in direction and structural support at gaps have been provided.
 11. Connections between assemblies have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
- B. Flexible flashings will be considered defective if they do not pass tests and inspections.
1. Remove and replace deficient self-adhering flexible flashings and retest as specified above.
- C. Repair damage to flexible flashings caused by testing; follow manufacturer's written instructions.
- D. Prepare test and inspection reports.
- 3.04 CLEANING AND PROTECTION
- A. Protect flexible flashings from damage during application and remainder of construction period, according to manufacturer's written instructions.
1. Protect flexible flashings from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace flexible flashing materials according to manufacturer's written instructions.
 2. Protect flexible flashings from contact with incompatible materials and sealants not approved by manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION

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SECTION 08 56 56.13 - SECURITY WINDOW GUARDS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Fixed security window guards.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For guards and accessories. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of metal finish required.

1.03 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 - 1. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.04 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.05 WARRANTY

- A. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E 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. Warranty Period: 10 years from date of Substantial Completion.

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PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Obtain fixed security window guards from single source from a single manufacturer of same type, design, and factory-applied color finish.
- B. Products: 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. Avant Guards Manufacturing; Expanded Metal Window Guards.

2.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of window guard components, noise or metal fatigue caused by window guard-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures are considered to act normal to the face of the building.
 - 1. Wind Loads:
 - a. Determine loads based on a uniform pressure of 20 lbf/sq. ft. , acting inward or outward.
- B. 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.

2.03 FIXED SECURITY WINDOW GUARDS

- A. General: Provide guards at openings indicated.
 - 1. Window Guard Location: Exterior face of window or opening.
- B. Secure window guard frames to adjacent construction with stainless steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Window Guard Frames: Fabricate with mitered corners to window guard sizes indicated.
 - 1. Metal: Same type and form of metal as indicated for window guard to which guards are attached.
 - 2. Finish: Same finish as window guards to which guards are attached.
- D. Expanded-Metal, Carbon Steel: ASTM F1267, Type II (expanded and flattened), Class 1 (uncoated).
 - 1. Style Designation: 1-1/2 number 10.

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2.04 MISCELLANEOUS MATERIALS

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Frames, Brackets, Flanges, and Anchors: Same metal and finish as window guards unless otherwise indicated.
- C. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- D. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use hex-head or Phillips pan-head tamper-resistant screws for exposed fasteners unless otherwise indicated.
 - 2. For fastening galvanized steel, use hot-dip-galvanized-steel or 300 series stainless steel fasteners.
- E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors.

2.05 FABRICATION

- A. Factory assemble security window guards to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Include supports, anchorages, and accessories required for complete assembly.
- D. Expanded-Metal Infill Panels: Fabricate infill panels from steel expanded-metal sheet.
 - 1. Edge panels with U-shaped channels made from same metal as infill; not less than 0.043 inch thick.
 - 2. Orient expanded metal with long dimension of diamonds **[as indicated on drawings] [horizontal] [vertical]**.

2.06 STEEL FINISHES

- A. Finish security window guards after assembly.
- B. Galvanized Window Guards:
 - 1. Hot-dip galvanize steel window guards, including hardware, after fabrication.
 - 2. Comply with ASTM A123/A123M for hot-dip galvanized window guards.
 - 3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
 - 4. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.

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5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- C. For galvanized window guards, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- D. Powder-Coat Finish for Galvanized Metal: Prepare, treat, and coat galvanized metal to comply with resin manufacturer's written instructions and as follows:
 1. Prepare galvanized metal by thoroughly removing grease, dirt, oil, flux, and other foreign matter.
 2. Treat prepared metal with zinc-phosphate pretreatment, rinse, and seal surfaces.
 3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness of not less than 1.5 mils.
 4. Color: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range].**

PART 3 - EXECUTION

3.01 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.

3.02 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.

3.03 INSTALLATION

- A. Locate and place security window guards level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible.
- C. Form closely fitted joints with exposed connections accurately located and secured.

3.04 ADJUSTING AND CLEANING

- A. Clean exposed security window guard surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

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- 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 security window guards 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

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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.
- 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
 - 6. Installation.
 - 7. Rough hardware.
 - 8. Conduit, junction boxes & wiring.
 - 9. Folding partitions, except cylinders where detailed.
 - 10. Sliding aluminum doors, except cylinders where detailed.
 - 11. Access doors and panels, except cylinders where detailed.
- 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 26 sections for connections to electrical power system and for low-voltage wiring.
 - 5. 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

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3361008000

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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.

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.

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- 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. Initiate and conduct meeting(s) with Owner representatives and hardware supplier to determine system keyway(s), keybow styles, structure, stamping, degree of physical security and degree of geographic exclusivity. Furnish Owner's written approval of the system; do not order keys or cylinders without written confirmation of actual requirements from the Owner.
 - b. 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.
 - c. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - d. 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.
 - e. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - f. 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.
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. 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.

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4. 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 representative for each manufacturer.
 - d. Final approved hardware schedule, edited to reflect conditions as-installed.
 - e. Final keying schedule
 - f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
 - g. 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. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 2. 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.
 3. 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.

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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 lbs (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 lbs (22.2 N).
 2. Maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbs (22.2 N) applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbs (22.2 N) applied parallel to door at latch.
 - c. Fire Doors: The minimum opening force allowable by the appropriate administrative authority, not to exceed 15 lbs (66.7N).
 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 closer so that the time required to move the door from the 90 degree position to 12 degrees from the latch is 5 seconds minimum.
- J. 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.
- K. Coordination Conferences:

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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 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.

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- 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:
 - 1. Prior to submittal, carefully inspect existing conditions to verify finish hardware required to complete Work, including sizes, quantities, existing hardware scheduled for re-use, and sill condition material. If conflict between the specified/scheduled hardware and existing conditions, submit request for direction from Architect. Include date of jobsite visit in the submittal.
 - 2. Submittals prepared without thorough jobsite visit by qualified hardware expert will be rejected as non-compliant.
- 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: 30 years.
 - b. Automatic Operators: 2 years
 - c. Exit Devices:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 - d. Locksets:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 - e. Continuous Hinges: Lifetime warranty
 - f. Key Blanks: Lifetime
 - 2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.9 MAINTENANCE

- A. Maintenance Tools:
 - 1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

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1.10 REGULATORY REQUIREMENTS:

- A. Locate latching hardware between 34 inches to 44 inches above the finished floor, per-2022 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. 2022 California Building Code Section 11B-309.4.
 - 2. Force required to activate the operable parts: 5.0 pounds maximum, per 2022 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 2022 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. Low-energy powered doors: comply with ANSI/BHMA A156.19. Reference: 2022 California Building Code Section 11B-404.2.9, Exception 2.
 - 1. Where powered door serves an occupancy of 150 or more, provide back-up battery power or stand-by generator power, capable of supporting a minimum of 100 cycles.
 - 2. Actuators, vertical bar type: minimum 2-inches wide, 30-inches high, bottom located minimum 5-inches above floor or ground, top located minimum 35-inches above floor or ground. Displays International Symbol of Accessibility, per 2022 California Building Code Section 11B-703.7.
 - 3. Actuators, plate type: use two at each side of the opening. Minimum 4-inches diameter or 4-inches square. Displays International Symbol of Accessibility, per 2022 California Building Code Section 11B-703.7. Locate centerline of lower plate between 7- and 8-inches above floor or ground, and upper plate between 30- and 44-inches above floor or ground.
 - 4. Actuator location: conspicuously located, clear and level floor/ground space for forward or parallel approach.
- E. 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 2022 California Building Code Section 11B-404.2.8.
 - 1. Spring hinges: adjust for 1.5 seconds minimum for 70 degrees to fully-closed.
- F. Smooth surfaces at bottom 10 inches of push sides of doors, facilitating push-open with wheelchair footrests, per 2022 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.

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- G. 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. 2022 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 2022 California Building Code 11B-307.4.
- H. Thresholds: floor or landing no more than 0.50 inches below the top of the threshold of the doorway, per 2022 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). 2022 California Building Code Section 11B-303.2 & ~.3.
- I. Floor stops: Do not locate in path of travel. Locate no more than 4 inches from walls, per DSA Policy #99-08 (Access).
- J. 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 2022 California Building Code Section 11B-703.4.2.
- K. Door and door hardware encroachment: Doors, when fully open, shall not reduce the required width by more than 7 inches. Doors in any position shall not reduce the required width by more than one-half. 2022 California Building Code, Section 1005.7.1.
 - 1. In I-2 occupancies, surface mounted latch release hardware is not permitted to project in the required egress width, regardless of its mounting height, per 2022 California Building Code, Section 1005.7.1 at Exception 1.
- L. In groups I-2 or I-2.1 occupancies, doors serving as a means of egress where used for the movement of beds and stretcher patients shall provide a minimum clear opening width of 44 inches. At pair openings that includes two door leaves without a mullion, one leaf shall provide a minimum clear opening width of 44 inches. 2022 California Building Code, Section 1010.1.1.
- M. In group I-2 or I-2.1 occupancies, there shall be no projections into the clear width of doors used for the movement of beds and stretcher patients in the means of egress. 2022 California Building Code, Section 1010.1.1.1 at Exception 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.

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- 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.

2.3 HINGES

A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product: Ives 5BB series
- 2. Acceptable Manufacturers and Products: No Substitute

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

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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.
12. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.

2.4 ELECTRIC POWER TRANSFER

- A. Manufacturers:
 - a. Scheduled Manufacturer: Von Duprin EPT-10
- B. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires sufficient to accommodate electric function of specified hardware.
- C. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.5 FLUSH BOLTS

- A. Manufacturers:

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1. Scheduled Manufacturer: Ives
- 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
- 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
 2. Acceptable Manufacturers and Products: No Substitute
- 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

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- 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: As scheduled.

2.8 EXIT DEVICES

A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product: Von Duprin 98 series
- 2. Acceptable Manufacturers and Products: No Substitute

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. Provide cylinder dogging at non-fire-rated exit devices.
- 10. 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.
- 11. 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.

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- a. Lever Style: Match lever style of locksets.
- 12. Accessibility: Maximum 5lbs force to retract latch bolt per CBC Chapter 11B.

“AX” feature: touchpad directly retracts the latchbolt with 5 lb or less of force. Provide testing lab certification confirming that the mechanical device is independent third-party tested to meet this 5 lb requirement.
- 13. Provide UL labeled fire exit hardware for fire rated openings.
- 14. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
- 15. Provide electrified options as scheduled.

2.9 ELECTRONIC ACCESS CONTROL LOCKSETS AND EXIT DEVICE TRIM

A. Manufacturers:

- 1. Scheduled Manufacturer: To establish standard of quality and design intent, electronic access control locksets and exit device trim specifications have been based on Schlage. Products of other manufacturers meeting or exceeding design and performance requirements specified herein will be considered for substitution subject to compliance with provisions of Division 01 Section “Product Requirements.”
- 2. Scheduled Manufacturer and Product: Schlage AD series.
- 3. Acceptable Manufacturers and Products: No substitute.

B. Product: Schlage AD-300-MS adaptable mortise-type electronic locksets.

- 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 field reversible for handing without opening case.
- 2. Backset: 2-3/4-inch (70 mm), nominal.
- 3. Latchbolt: 3-piece, beveled, stainless steel with 3/4-inch (19 mm) throw and anti-friction latch.
- 4. Deadbolt: Where deadbolt function is scheduled, provide stainless steel deadbolt interconnected with latch 1-5/8-inch (41 mm) high and 5/8-inch (16 mm) thick with 1-inch throw.
- 5. Chassis: ANSI/BHMA standard mortise lock prep for 1-3/4-inch (44 mm) doors

C. Product: Schlage AD-300-993 adaptable electronic exit device trim.

- 1. Provide exit device trim conforming to ANSI/BHMA A156.25, non-handed, field-reversible.
- 2. Exit Device Configurations: Exit device lever trim to retract latchbolt for following exit device applications:
 - a. Rim
- 3. Exit Device Compatibility: Provide exit device trim with universal mounting plate enabling operation as required.

D. Requirements:

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1. Provide adaptable electronic access control products that comply with the following requirements:
 - a. Listed, UL 294 - The Standard of Safety for Access Control System Units.
 - b. Compliant with ANSI/BHMA A156.25 Grade 1 Operation and Security.
 - c. Certified to UL10C, FCC Part15, Florida Building Code Standards TAS 201 large missile impact, TAS 202 and TAS 203.
 - d. Compliant with ASTM E330 for door assemblies.
 - e. Compliant with ICC / ANSI A117.1, NFPA 101, NFPA 80, and Industry Canada IC.
2. Functions: Provide functions as scheduled that are field configurable without taking the adaptable electronic product off the door.
3. Emergency Override: Provide mechanical key override; cylinders: Refer to "KEYING" article, herein.
4. Levers:
 - a. Vandal Resistance: Exterior (secure side) lever rotates freely while door remains locked, preventing damage to internal lock components from vandalism by excessive force.
 - b. Provide non-handed lever trim that operates independently of non-locking levers.
 - c. Style: Rhodes (06)
 - d. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.
5. Power Supply:
 - a. Offline – access control rights stored on device and access control rights stored on magnetic stripe credential
 - 1) Adaptable electronic access control products powered by four AA batteries with options for eight AA batteries or a 12V or 24V DC power supply.
 - 2) Provide adaptable electronic access control products with the ability to communicate battery status.
 - b. Networked – hardwired
 - 1) Adaptable electronic access control products powered by 12VDC or 24VDC power supply with max current draw not to exceed 250mA.
 - c. Networked – wireless
 - 1) Adaptable electronic access control products powered by four AA batteries with options for eight AA batteries or a 12V or 24V DC power supply.
 - 2) Provide adaptable electronic access control products with the ability to communicate battery status and battery voltage level by means of a handheld programming device at door and remotely by Partner integrated software.
6. Features:
 - a. Audible feedback that can be enabled or disabled.
 - b. Tamper-Resistant Screws: Tamper torx screws on inside escutcheon for increased security.
 - c. Offline – access control rights stored on device

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- 1) Visual tri-colored LED indicators that indicate activation, additional PIN code credential required, operational systems status, system error conditions and low power conditions.
 - 2) Visual bi-colored LED indicator on interior that is capable of indicating secured/unsecured status of device to occupants on interior.
 - 3) Onboard processor with memory capacity of 5,000 users, 5,000 event audit history, up to 16 time zones and up to 32 calendar events.
- d. Offline – access control rights stored on magnetic stripe credential
- 1) Visual tri-colored LED indicators that indicate activation, operational systems status, system error conditions and low power conditions.
 - 2) Onboard processor with memory capacity of 10,000 event audit history, up to 16 time zones and up to 32 calendar events.
- e. Networked – hardware and wireless
- 1) Ability to communicate unit's communication status.
 - 2) Visual tri-colored LED indicators that indicate activation, additional PIN code credential required, operational systems status, system error conditions and low power conditions.
 - 3) Visual bi-colored LED indicator on interior that is capable of indicating secured/unsecured status of device to occupants on interior.
7. Adaptability:
- a. Field changeable Reader Modules: Adaptable electronic access control products to have the ability to change credential reader technologies without being removed from door.
 - b. Offline
 - 1) Networking Capabilities: Network adaptable without removing device from door. Adaptable electronic access control products to have the ability to be upgraded in the field from a standalone battery powered configuration to a wireless networked configuration without being removed from the door.
 - c. Networked
 - 1) Open Architecture: Adaptable electronic access control products manufactured with open architecture characteristics capable of handling new and existing access control software and credential reading technology.
8. Switches: Provide adaptable electronic access control products with the following switches, standard:
- a. Door Position Switch
 - b. Interior Cover Tamper Guard
 - c. Mechanical Key Override
 - d. Request to Exit
 - e. Request to Enter
 - f. Lock/Unlock Status (Clutch Position).
9. Credential Reader:
- a. Networked – hardwired
 - 1) Credential Reader Configuration: Provide credential reader modules in the following configurations, as indicated in door hardware sets. Multi-tech

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contactless reader shall be NFC-Compatible and read access control data from both 125 kHz and 13.56 MHz contactless smart cards. The multi-tech contactless reader shall be optimally designed for use in access control applications that require reading both 125 kHz proximity and 13.56 MHz contactless smart cards.

- a) Proximity, Smartcard via Multi-Technology.
- b) Proximity, Smartcard via Multi-Technology and keypad.
- 2) Credential Reader Capabilities: Provide credential readers capable of being configured at lockset with handheld programming device and remotely operated with the following integrated software partners.
 - a) 13.56 MHz Smart card credentials:
 - i. Secure section (Multi-Technology and Smartcard): Schlage MIFARE Classic, Schlage MIFARE DESFire EV1, PIV and PIV-I Compatible
 - ii. 13.56 MHz Serial number only (Multi-Technology and Smartcard): MIFARE, DESfire, HID iClass, MIFARE DESFire EV1
 - iii. 125 kHz Proximity card credentials: Schlage, XceedID, HID, GE/CASI ProxLite and AWID.
 - b) Multi-Technology readers that read both 13.56 MHz Smart Cards and 125 kHz Prox cards.
 - c) Dual credential reading capabilities credential card or fob and PIN.

10. Operation:

- a. Networked – hardwired
 - 1) Adaptable electronic access control product system interface:
 - a) Wiegand or Clock & Data via PIB300 (Panel Interface Board).
 - b) Directly via RS485.
 - 2) Adaptable electronic access control products to have real-time bidirectional communication between access control system and lock.
 - 3) Credential Verification Time: less than 1 second.
 - 4) When Utilized with Partner Integrated Access Control Network Software With Remote Commanding Capability: Provide adaptable electronic access control product with the ability to be remotely locked down or unlocked within 10 seconds or less, without user interface at the device.
 - 5) Upon Loss of Power to Device: Provide adaptable electronic access control product with the ability to manage access control offline in one of three methods below that can be configured in the field at lockset by handheld programming device and remotely by Partner integrated software:
 - a) Fail locked (secured)
 - b) Fail unlocked (unsecured)
 - c) Fail As-Is
 - 6) Upon Loss of Communication Between Device and Network: Provide adaptable electronic access control product with the ability to manage access control offline in one of four methods below that can be configured in the field at device by handheld programming device and remotely by Partner integrated software:
 - a) Fail locked (secured)
 - b) Fail unlocked (unsecured)
 - c) Fail As-Is
 - d) Fail to Degraded/cache mode utilizing cache memory with following selectable options:
 - i. Grant access up to the last 1,000 unique previously accepted User IDs.
- ii. Grant access up to the last 1,000 unique previously accepted facility/site codes.
- iii. Remove from cache previously stored User IDs or facility/site codes that have not been presented to lock within the last 5 days.

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- 7) Provide adaptable electronic access control product with the ability to be configured at door by handheld programming device and remotely by Partner integrated software the length of time device is unlocked upon access grant.
- 8) Provide adaptable electronic access control product with the ability to communicate identifying information such as firmware versions, hardware versions, serial numbers, and manufacturing dates by handheld programming device and remotely by Partner integrated software.

E. Components

1. Product: Schlage HHD series with Utility Software.
 - a. Provide Handheld Programming Device for adaptable electronic access control products capable of the following minimum requirements.
 - 1) Capable of initializing lock and accessories using preloaded software.
 - 2) Utilized to field configure electronic access control devices, to download firmware updates and door files to device, and to download audit files from device.
2. Product: Schlage PIB300-2D Panel Interface Board.
 - a. Provide Panel Interface Board for hardwired adaptable electronic access control products capable of the following minimum requirements.
 - 1) Used to connect hardwired adaptable electronic access control products to the access control board or reader interface board, where Wiegand or Clock & Data protocol is required.
 - 2) Applicable Standards:
 - a) Listed, UL 294 - The Standard of Safety for Access Control System Units.
 - b) Compliant with NEMA 1, 4, 4X, 6.
 - c) Certified to FCC Part15, Florida Building Code Standards.
 - d) Compliant to ASTM E3300 and IC (Canada).
 - 3) Power Supply: 12VDC or 24VDC.
 - 4) Status Indicators: 13 LEDs minimum.

2.10 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage or Von Duprin PS900 series

B. Requirements:

1. Provide power supplies, recommended and approved by manufacturer of electrified locking component, for operation of electrified locks, electrified exit devices, magnetic locks, electric strikes, and other components requiring power supply.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply , and UL class 2 listed.
4. Options:
 - a. Provide power supply, where specified, with internal capability of charging sealed backup batteries 24 VDC, in addition to operating DC load.

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- b. Provide sealed batteries for battery back-up at each power supply where specified.
 - c. Provide keyed power supply cabinet.
- 5. Provide power supply in an enclosure, complete, and requiring 120VAC to fused input.
 - 6. Provide power supply with emergency release terminals, where specified, that allow release of all devices upon activation of fire alarm system complete with fire alarm input for initiating "no delay" exiting mode.

2.11 CYLINDERS

A. Manufacturers:

- 1. Scheduled Manufacturer: Schlage SFIC Everest RP
- 2. Acceptable Manufacturers: No Substitute

B. Requirements:

- 1. Provide permanent small format interchangeable core (SFIC) cylinders/cores to match Owner's existing key system, 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.
 - 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.

2.12 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. 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.
- 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:

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- 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" along with the "PATENTED" or patent number to enforce the patent protection.
 - 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. Permanent Control Keys: 3.
 - c. Master Keys: 6.

2.13 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer: Telkee
2. Acceptable Manufacturers: HPC, Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

2.14 DOOR CLOSERS

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 piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.

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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. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
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: No Substitute

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: No Substitute

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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

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: No Substitute

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.

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2.19 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: Zero International

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 FINISHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. 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. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Existing frames and doors to be retrofitted with new hardware:
 1. Field-verify conditions and dimensions prior to ordering hardware. Fill existing hardware cut outs not being reused by the new hardware. Remove existing hardware not being reused, return to Owner unless directed otherwise.

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2. Remove existing floor closers not scheduled for reuse, fill cavities with non-shrinking concrete and finish smooth.
3. Cut and weld existing steel frames currently prepared with 2.25 inch height strikes. Cut an approximate 8 inch section from the strike jamb and weld in a reinforced section to accommodate specified hardware's strike.
4. Patch and weld flush filler pieces into existing door hardware preparations in steel doors and frames, leave surfaces smooth.

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

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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. 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.
- I. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.
 - 3. Connections to fire/smoke alarm system and smoke evacuation system.
 - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 - 5. Testing and labeling wires with Architect's opening number.
- 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. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
 - 1. Coordination: Coordinate provision with the security systems provider to mitigate excessive or redundant purchase.
 - 2. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
- N. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- O. 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.
- P. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- Q. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- R. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- S. Field-verify existing conditions and measurements prior to ordering hardware. Fill existing hardware cut outs not being used by the new hardware.
- T. Remove existing hardware not being reused. Tag and bag removed hardware, turn over to Owner.
- U. Where existing wall conditions will not allow door to swing using the scheduled hinges, provide wide-throw hinges and if needed, extended arms on closers.
- V. Provide manufacturer's recommended brackets to accommodate the mounting of closers on doors with flush transoms.

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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. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
 - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 3. 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. Do not order material until submittal has been reviewed, stamped, and signed by Architect's door hardware consultant.
- C. Hardware Sets:

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86524 OPT0311735 Version 1
HW SET: 01

Door(s):

	R-01A	R-01B	R-08A	R-08B	R-14A	R-14B		
	R-18A	R-18B						
6	EA	HINGE		5BB1HW SH 4.5 X 4.5 NRP	📄	630	IVE	
2	EA	POWER TRANSFER		EPT10	📄	689	VON	
1	EA	REMOVABLE MULLION		KR4954 STAB	📄	689	VON	
2	EA	ELEC PANIC HARDWARE		RX-LC-PA-AX-98-EO	📄	626	VON	
1	EA	AD993 IPB RETROFIT KIT		47385857/47385858			SCH	
1	EA	MULLION STORAGE KIT		MT54		689	VON	
1	EA	ELEC EXIT DEVICE TRIM		**AD-300-993R-50-MT-RHO-B 12/24 VDC	📄	626	SCE	
1	EA	SFIC MORTISE CYL.		80-132 GRN X K510-730	📄	626	SCH	
2	EA	SFIC EVEREST CORE		*80-037 EV29 R	📄	626	SCH	
1	EA	SFIC CONST. CORE		80-035 GRN			SCH	
2	EA	OH STOP		100S	📄	630	GLY	
2	EA	SURFACE CLOSER		4040XP EDA ST-1944	📄	689	LCN	
2	EA	KICK PLATE		8400 10" X 1 1/2" LDW B-CS	📄	630	IVE	
1	SET	GASKETING		429AA-S	📄	AA	ZER	
1	EA	MULLION SEAL		8780NBK PSA	📄	BK	ZER	
2	EA	DOOR SWEEP		39A	📄	A	ZER	
1	EA	THRESHOLD		102A OR AS DETAILED	📄	A	ZER	

* = CONSULT DISTRICT FOR KEYING DETAILS

** = AD-300 LOCKSET/EXIT DEVICE TRIM LISTED FOR TEMPLATING PURPOSES ONLY.
LOCKSET/EXIT DEVICE TRIM SUPPLIED BY DIV. 28.

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DOOR HARDWARE
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HW SET: 02

Door(s):

R-14C

R-18C

6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
2	EA	POWER TRANSFER	EPT10		689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
2	EA	ELEC PANIC HARDWARE	RX-LC-PA-AX-98-EO		626	VON
1	EA	MULLION STORAGE KIT	MT54		689	VON
1	EA	ELEC EXIT DEVICE TRIM	**AD-300-993R-50-MT-RHO-B 12/24 VDC		626	SCE
1	EA	SFIC MORTISE CYL.	80-132 GRN X K510-730		626	SCH
2	EA	SFIC EVEREST CORE	*80-037 EV29 R		626	SCH
1	EA	SFIC CONST. CORE	80-035 GRN			SCH
2	EA	OH STOP	100S		630	GLY
2	EA	SURFACE CLOSER	4040XP EDA		689	LCN
2	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
1	EA	THRESHOLD	545A OR AS DETAILED		A	ZER

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DOOR HARDWARE
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ARROYO HIGH SCHOOL - MODERNIZATION
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HW SET: 03

Door(s):

	R-14D	R-14E	R-18D	R-18E			
3	EA	HINGE		5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	POWER TRANSFER		EPT10		689	VON
1	EA	ELEC PANIC HARDWARE		RX-LC-PA-AX-98-EO		626	VON
1	EA	AD993 IPB RETROFIT KIT		47385857/47385858			SCH
1	EA	ELEC EXIT DEVICE TRIM		**AD-300-993R-50-MT-RHO-B 12/24 VDC		626	SCE
1	EA	SFIC EVEREST CORE		*80-037 EV29 R		626	SCH
1	EA	SFIC CONST. CORE		80-035 GRN			SCH
1	EA	OH STOP		100S		630	GLY
1	EA	SURFACE CLOSER		4040XP EDA		689	LCN
1	EA	KICK PLATE		8400 10" X 1 1/2" LDW B-CS		630	IVE
1	EA	GASKETING		188SBK PSA		BK	ZER
1	EA	THRESHOLD		545A OR AS DETAILED		A	ZER

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HW SET: 04

Door(s):

	R-06A	R-06B				
3	EA	HINGE	5BB1HW SH 4.5 X 4.5 NRP		630	IVE
1	EA	POWER TRANSFER	EPT10		689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-PA-AX-98-EO		626	VON
1	EA	AD993 IPB RETROFIT KIT	47385857/47385858			SCH
1	EA	ELEC EXIT DEVICE TRIM	**AD-300-993R-50-MT-RHO-B 12/24 VDC		626	SCE
1	EA	SFIC EVEREST CORE	*80-037 EV29 R		626	SCH
1	EA	SFIC CONST. CORE	80-035 GRN			SCH
1	EA	SURFACE CLOSER	4040XP EDA ST-1944		689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS18S/FS18L		BLK	IVE
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A OR AS DETAILED		A	ZER

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HW SET: 05

Door(s):

	R-19A	R-19B				
3	EA	HINGE	5BB1HW SH 4.5 X 4.5 NRP		630	IVE
1	EA	CLASSROOM SECURITY	L9071HD 06A L283-711		626	SCH
2	EA	SFIC EVEREST CORE	*80-037 EV29 R		626	SCH
1	EA	LOCK GUARD	LG1		630	IVE
1	EA	SURFACE CLOSER	4040XP EDA ST-1944		689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS18S/FS18L		BLK	IVE
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A OR AS DETAILED		A	ZER

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HW SET: 06

Door(s):

R-05

6	EA	HINGE	5BB1HW SH 4.5 X 4.5 NRP		630	IVE
1	SET	AUTO FLUSH BOLT	FB31P/FB41P		630	IVE
1	EA	DUST PROOF STRIKE	DP1/DP2 AS REQ'D		626	IVE
1	EA	CLASSROOM LOCK	L9070HD 06A 10-072 7/8" LIP		626	SCH
1	EA	SFIC EVEREST CORE	*80-037 EV29 R		626	SCH
1	EA	COORDINATOR	COR X FL		628	IVE
2	EA	MOUNTING BRACKET	MB		689	IVE
1	EA	OH STOP	100S		630	GLY
2	EA	SURFACE CLOSER	4040XP EDA ST-1944		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS18S/FS18L		BLK	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER
			@ HEADER			
1	SET	GASKETING	328AA-S		AA	ZER
			@ JAMBS			
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	ASTRAGAL	44STST		STST	ZER
1	EA	THRESHOLD	102A OR AS DETAILED		A	ZER

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HW SET: 07

Door(s):

	R-03	R-11	R-15	R-17			
6	EA	HINGE		5BB1 4.5 X 4.5 NRP		652	IVE
1	SET	AUTO FLUSH BOLT		FB31P/FB41P		630	IVE
1	EA	DUST PROOF STRIKE		DP1/DP2 AS REQ'D		626	IVE
1	EA	CLASSROOM LOCK		L9070HD 06A 10-072 7/8" LIP		626	SCH
1	EA	SFIC EVEREST CORE		*80-037 EV29 R		626	SCH
1	EA	COORDINATOR		COR X FL		628	IVE
2	EA	MOUNTING BRACKET		MB		689	IVE
2	EA	SURFACE CLOSER		4040XP EDA ST-1754		689	LCN
2	EA	KICK PLATE		8400 10" X 1" LDW B-CS		630	IVE
2	EA	WALL STOP		WS401/402CCV		626	IVE
				REQUIRES BACKING IN WALL			
1	EA	ASTRAGAL		44STST		STST	ZER
2	EA	SILENCER		SR64/SR65		GRY	IVE

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HW SET: 08

Door(s):

	R-02	R-09					
3	EA	HINGE		5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM DEAD LOCK		L463HD XB11-720		626	SCH
1	EA	SFIC EVEREST CORE		*80-037 EV29 R		626	SCH
1	EA	PUSH PLATE		8200 4" X 16" CFC		630	IVE
1	EA	PULL PLATE		8303 10" 4" X 16" CFT L		630	IVE
1	EA	SURFACE CLOSER		4040XP REG OR PA AS REQ		689	LCN
1	EA	KICK PLATE		8400 10" X 1 1/2" LDW B-CS		630	IVE
1	EA	MOP PLATE		8400 4" X 1" LDW B-CS		630	IVE
1	EA	FLOOR STOP		FS436/438 AS REQ'D		626	IVE
3	EA	SILENCER		SR64/SR65		GRY	IVE

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HW SET: 09

Door(s):

R-10

3	EA	HINGE	5BB1HW SH 4.5 X 4.5 NRP		630	IVE
1	EA	STOREROOM LOCK	L9080HD 06A		626	SCH
1	EA	SFIC EVEREST CORE	*80-037 EV29 R		626	SCH
1	EA	LOCK GUARD	LG1		630	IVE
1	EA	SURFACE CLOSER	4040XP EDA ST-1944		689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS18S/FS18L		BLK	IVE
1	SET	GASKETING	429AA-S		AA	ZER
1	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	102A OR AS DETAILED		A	ZER

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HW SET: 10

Door(s):

R-12

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	L9080HD 06A		626	SCH
1	EA	SFIC EVEREST CORE	*80-037 EV29 R		626	SCH
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP ST-1630		689	LCN
1	EA	TOP JAMB MTG PLATE	4040XP-18TJ		689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS		630	IVE
1	EA	GASKETING	188SBK PSA		BK	ZER

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HW SET: 11

Door(s):

R-04

3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	FIRE EXIT HARDWARE	PA-AX-98-L-NL-F-06		626	VON
1	EA	SFIC RIM CYLINDER	80-159 GRN		626	SCH
1	EA	SFIC EVEREST CORE	*80-037 EV29 R		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA TBWMS		689	LCN
1	EA	KICK PLATE	8400 10" X 1 1/2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS401/402CCV		626	IVE
			REQUIRES BACKING IN WALL			
1	EA	GASKETING	188SBK PSA		BK	ZER

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END OF SECTION

ARROYO HIGH SCHOOL - MODERNIZATION
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SECTION 09 01 90.52 - MAINTENANCE REPAINTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes cleaning, repair, and surface preparation of previously painted interior and exterior substrates.
- B. Related Sections:
 - 1. Division 09 painting Sections for paint materials and systems for new coatings applied over previously painted substrates.

1.02 PREINSTALLATION MEETINGS

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

1.03 SEQUENCING AND SCHEDULING

- A. Perform maintenance repainting in the following sequence, which includes work specified in this and other Sections:
 - 1. Dismantle existing surface-mounted objects and hardware except items indicated to remain in place. Tag items with location identification and protect.
 - 2. Verify that temporary protections have been installed.
 - 3. Examine condition of surfaces to be painted.
 - 4. Remove existing paint to the degree required for each substrate and surface condition of existing paint.
 - 5. Apply paint system.
 - 6. Reinstall dismantled surface-mounted objects and hardware unless otherwise indicated.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include recommendations for product application and use.
 - 2. Include test data substantiating that products comply with requirements.

1.05 INFORMATIONAL SUBMITTALS

- A. Preconstruction Manufacturer's Inspection Report: For substrate preparation and primers.

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1.06 QUALITY ASSURANCE

- A. Mockups: Prepare mockups of maintenance repainting processes for each type of coating system and substrate indicated and each color and finish required to demonstrate aesthetic effects and to set quality standards for materials and execution. Duplicate appearance of approved Sample submittals.
1. Locate mockups on existing surfaces where directed by Architect.
 2. Surface-Preparation Mockups: On existing surfaces using applicable specified methods of cleaning and other surface preparation, provide mockup sample of at least 100 sq. ft..
 3. Coating Mockups: Two surfaces of at least 100 sq. ft. to represent surfaces and conditions for application of each type of coating system under same conditions as the completed Work.
 4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.07 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing of cleaning materials, paint removers and compatibility of paint coatings and systems for each type of painted surface.
1. Use test areas as indicated and representative of proposed materials and existing construction.
 2. Propose changes to materials and methods to suit Project.

1.08 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 daily.

PART 2 - PRODUCTS

2.01 PREPARATORY CLEANING MATERIALS

- A. Water: Potable.
- B. Hot Water: Water heated to a temperature of 140 to 160 deg F.

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- C. Detergent Solution: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent that contains no ammonia, 5 quarts of 5 percent sodium hypochlorite bleach, and 15 quarts of warm water for every 5 gal. of solution required.
- D. Mildewcide: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing 1/3 cup of household detergent that contains no ammonia, 1 quart of 5 percent sodium hypochlorite bleach, and 3 quarts of warm water.
- E. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.
- F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation for removing corrosion from iron and steel.

2.02 PAINT MATERIALS

- A. Provide paint products and systems in accordance with Division 09 painting Sections.
- B. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the paint system.

2.03 PATCHING MATERIALS

- A. Metal-Patching Compound: Two-part, polyester-resin, metal-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of metal repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be produced for filling metal that has deteriorated from corrosion. Filler shall be capable of filling deep holes and spreading to feather edge.
- B. Cementitious Patching Compounds: Cementitious patching compounds and repair materials specifically manufactured for filling cementitious substrates and for sanding or tooling prior to repainting; formulation as recommended in writing by manufacturer for type of cementitious substrate indicated, exposure to weather and traffic, the detail of work, and site conditions.
- C. Gypsum-Plaster Patching Compound: Finish coat plaster and bonding compound according to ASTM C842 and manufacturer's written instructions.

PART 3 - EXECUTION

3.01 PROTECTION

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

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1. Cover adjacent surfaces with materials that are proven to resist chemical solutions being used unless the solutions will not damage adjacent surfaces. Use protective materials that are UV resistant and waterproof. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
2. Do not apply chemical solutions during winds of sufficient force to spread them to unprotected surfaces.
3. Neutralize and collect alkaline and acid wastes before disposal.
4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

3.02 MAINTENANCE REPAINTING, GENERAL

- A. Execution of the Work: In repainting surfaces, disturb them as minimally as possible and as follows:
 1. Remove failed coatings and corrosion and repaint.
 2. Verify that substrate surface conditions are suitable for repainting.
 3. Allow other trades to repair items in place before repainting.
- B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use gentle methods, such as scraping and lightly hand sanding, that will not abrade softer substrates, reducing clarity of detail.
- C. Heat Processes: Do not use torches, heat guns, or heat plates.

3.03 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of painting work. Comply with paint manufacturer's written instructions for inspection.
- B. Maximum Moisture Content of Substrates: Do not begin application of coatings unless moisture content of exposed surface is below the maximum value recommended in writing by paint manufacturer and not greater than the following maximum values when measured with an electronic moisture meter appropriate to the substrate material:
 1. Concrete: 12 percent.
 2. Gypsum Board: 12 percent.
 3. Gypsum Plaster: 12 percent.
 4. Masonry (Clay and CMU): 12 percent.
 5. Portland Cement Plaster: 12 percent.
 6. Wood: 15 percent.
- C. Alkalinity: Do not begin application of coatings unless surface alkalinity is within range recommended in writing by paint manufacturer. Conduct alkali testing with litmus paper on exposed plaster, cementitious, and masonry surfaces.

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- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
 - 1. If existing surfaces cannot be prepared to an acceptable condition for proper finishing by using specified surface-preparation methods, notify Architect in writing.
- E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.04 PREPARATORY CLEANING

- A. General: Use the gentlest, appropriate method necessary to clean surfaces in preparation for painting. Clean all surfaces, corners, contours, and interstices.
- B. Detergent Cleaning: Wash surfaces by hand using clean rags, sponges, and bristle brushes. Scrub surface with detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Rinse with water applied by clean rags or sponges.
- C. Solvent Cleaning: Use solvent cleaning to remove oil, grease, smoke, tar, and asphalt from painted or unpainted surfaces before other preparation work. Wipe surfaces with solvent using clean rags and sponges. If necessary, spot-solvent cleaning may be employed just prior to commencement of paint application, provided enough time is allowed for complete evaporation. Use clean solvent and clean rags for the final wash to ensure that all foreign materials have been removed. Do not use solvents, including primer thinner and turpentine, that leave residue.
- D. Mildew: Clean off existing mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. Rinse with water applied by clean rags or sponges.
- E. Mechanical Rust Removal:
 - 1. Remove rust with specified abrasives for ferrous-metal cleaning. Clean to bright metal.
 - 2. Wipe off residue with mineral spirits and either steel wool or soft rags.
 - 3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
 - 4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

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3.05 PAINT REMOVAL

- A. General: Remove paint where where required by coating system manufacturer. Where cleaning methods have been attempted and further removal of the paint is required because of incompatible or unsatisfactory surfaces for repainting, remove paint to extent required by conditions.
1. Application: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
 - a. Apply materials to all surfaces, corners, contours, and interstices, to provide a uniform final appearance without streaks.
 - b. After work is complete, remove protection no longer required. Remove tape and adhesive marks.
 2. Brushes: Use brushes that are resistant to chemicals being used.
 - a. Metal Substrates: If using wire brushes on metal, use brushes of same metal composition as metal being treated.
 - b. Wood Substrates: Do not use wire brushes.
 3. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.
- B. Paint Removal with Hand Tools: Remove paint manually using hand-held scrapers, wire brushes, sandpaper, and metallic wool as appropriate for the substrate material.

3.06 SUBSTRATE REPAIR

- A. General: Repair substrate surface defects that are inconsistent with the surface appearance of adjacent materials and finishes.
- B. Wood Substrate:
1. Repair wood defects including dents and gouges more than 1/8 inch in size and all holes and cracks by filling with wood-patching compound and sanding smooth. Reset or remove protruding fasteners.
 2. Where existing paint is allowed to remain, sand irregular buildup of paint, runs, and sags to achieve a uniformly smooth surface.
- C. Cementitious Material Substrate:
1. General: Repair defects including dents and chips more than 1/2 inch in size and all holes and cracks by filling with cementitious patching compound and sanding smooth. Remove protruding fasteners.
 2. Concrete, Cement Plaster, and Other Cementitious Products: Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. If surfaces are too alkaline to paint, correct this condition before painting.
- D. Gypsum-Plaster and Gypsum-Board Substrates:

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1. Repair defects including dents and chips more than [1/8 inch] [1/4 inch] <Insert dimension> in size and all holes and cracks by filling with gypsum-plaster patching compound and sanding smooth. Remove protruding fasteners.
2. Rout out surface cracks to remove loose, unsound material; fill with patching compound and sand smooth.

E. Metal Substrate:

1. Preparation: Treat repair locations by wire-brushing and solvent cleaning. Use mechanical rust removal method to clean off rust.
2. Priming: Prime iron and steel surfaces immediately after repair to prevent flash rusting. Stripe paint corners, crevices, bolts, welds, and sharp edges. Apply two coats to surfaces that are inaccessible after completion of the Work.

3.07 PAINT APPLICATION, GENERAL

- A. Comply with manufacturers' written instructions for application methods unless otherwise indicated in this Section.
- B. Prepare surfaces to be painted according to the Surface-Preparation Schedule and with manufacturer's written instructions for each substrate condition.
- C. Apply a transition coat over incompatible existing coatings.
- D. Metal Substrate: Stripe paint corners, crevices, bolts, welds, and sharp edges before applying full coat. Apply two coats to surfaces that are inaccessible after completion of the Work. Tint stripe coat different than the main coating and apply with brush.
- E. Blending Painted Surfaces: When painting new substrates patched into existing surfaces or touching up missing or damaged finishes, apply coating system specified for the specific substrate. Apply final finish coat over entire surface from edge to edge and corner to corner.

3.08 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage manufacturer's service representative for consultation and Project-site inspection and to provide on-site assistance when requested by Architect.

3.09 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.

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- 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.

END OF SECTION

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SECTION 09 64 66.61 - WOOD ATHLETIC FLOORING REFINISHING

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes refinishing wood athletic flooring.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of floor assembly, include the following:
 1. Layout, colors, widths, and dimensions of game lines and markers.
 2. Locations of floor inserts for athletic equipment installed through flooring assembly.

1.03 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wood athletic flooring and finish systems to include in maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual that has been approved by MFMA as an accredited Installer according to the MFMA Accreditation Program.
 1. Installer responsibilities include installation and field finishing of wood athletic flooring components and accessories, and application of game lines and markers.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver floor assembly materials in unopened cartons or bundles.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 1. Acer Flooring; <Insert product designation>.
 2. Action Floor Systems, LLC; <Insert product designation>.
 3. Bona; SuperSport System.
 4. Connor Sports; <Insert product designation>.
 5. Horner Sports Flooring; <Insert product designation>.
 6. Robbins Sports Surfaces; <Insert product designation>.
 7. WD Flooring, LLC; <Insert product designation>.

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2.02 FINISHES

- A. Floor-Finish System: System of compatible components recommended in writing by flooring manufacturer, and MFMA approved.
 - 1. Floor-Sealer Formulation: Pliable, penetrating type. MFMA Group 1, Sealers.
 - 2. Finish-Coat Formulation: Formulated for gloss finish indicated and multicoat application.
 - a. Type: **[MFMA Group 3, Gymnasium-Type Surface Finishes] [MFMA Group 5, Water-Based Finishes] <Insert finish>**.
 - 3. Game-Line and Marker Paint: Industrial enamel compatible with finish coats and recommended in writing by manufacturers of finish coats, and paint for this use.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, 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.

3.02 PREPARATION

- A. Remove existing gymnasium floor finish, including the finish, paint and game lines, with specialized sanding equipment.
- B. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 SANDING AND FINISHING

- A. Follow applicable recommendations in MFMA's "Industry Recommendations for Sanding, Sealing, Court Lining, Finishing, and Resurfacing of Maple Gym Floors."
- B. Machine sand with coarse, medium, and fine grades of sandpaper to achieve a level, smooth, uniform surface without ridges or cups. Remove sanding dust by tack or vacuum.
- C. Finish: Apply seal and finish coats of finish system according to finish manufacturer's written instructions. Provide no fewer than **[four] <Insert number>** coats total and no fewer than **[two] <Insert number>** finish coats.
 - 1. Water-Based Finishes: Use finishing methods recommended by finish manufacturer to reduce grain raise and sidebonding effect.

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2. Game-Line and Marker Paint: Apply game-line and marker paint between final seal coat and first finish coat according to paint manufacturer's written instructions.
 - a. Mask flooring at game lines and markers, and apply paint to produce lines and markers with sharp edges.
 - b. Where game lines cross, break minor game line at intersection; do not overlap lines.
 - c. Apply game lines and markers in widths and colors according to **[requirements indicated on Drawings] <Insert name of sport association publication>**.
 - d. Apply finish coats after game-line and marker paint is fully cured.

3.04 PROTECTION

- A. Protect wood athletic flooring during remainder of construction period to allow finish to cure and to ensure that flooring and finish are without damage or deterioration at time of Substantial Completion.
 1. Do not cover flooring after finishing until finish reaches full cure and not before seven days after applying last finish coat.
 2. Do not move heavy and sharp objects directly over flooring. Protect fully cured floor finishes and surfaces with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION

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SECTION 09 84 33 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes shop-fabricated, sound-absorbing wall panel units tested for acoustical performance.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For sound-absorbing wall units. Include mounting devices and details.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide sound-absorbing wall units meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.

2.02 SOUND-ABSORBING WALL UNITS

- A. Wood Fiber Wall Panels: Manufacturer's standard panel construction consisting of wood fiber bonded by inorganic binder.
 - 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. Tectum; an Armstrong World Industries brand.

2.03 MATERIALS

- A. Aluminum Trim:
- B. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as follows:

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PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install sound-absorbing wall units in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with sound-absorbing wall unit manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Clip loose threads; remove pills and extraneous materials.
- D. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION

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SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Surface preparation and the application of paint systems on interior and exterior substrates.

1.02 DEFINITIONS

- A. Sheen Levels:
 - 1. Flat: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
 - 2. Eggshell: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
 - 3. Satin: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
 - 4. Semi-Gloss: 35 to 70 units at 60 degrees, according to ASTM D 523.
 - 5. Gloss: 70 units and greater at 60 degrees, according to ASTM D 523.

1.03 SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Sustainable Design Submittals:
 - 1. Product Data: For paints and coatings, indicating VOC content.
- C. 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. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.

1.04 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.

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- a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 3 articles for the paint category indicated.

2.02 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Paint Colors (PNT): As indicated in a color schedule.

PART 3 - EXECUTION

3.01 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. Masonry (Clay and CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
 - 5. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- 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.

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1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. General: Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates 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. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized Metal Substrates:
 1. Metal Substrates Galvanized in Accordance with ASTM A 123 and ASTM A 153: Prepare substrates in accordance with ASTM D 6386.
 2. Other Galvanized Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 2. Sand surfaces that will be exposed to view, and dust off.
 3. Prime edges, ends, faces, undersides, and backsides of wood.

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4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.03 APPLICATION

- A. Apply paints according to manufacturer's written instructions and as follows:
 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 sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting 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.
 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. Other items as directed by Architect.

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3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.04 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.

3.05 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 INTERIOR PAINTING SCHEDULE

- A. Gypsum Board; Acrylic Latex: Provide one of the following systems:
 1. Benjamin Moore:
 - a. Primer: Ultra Spec 500 Interior Latex Primer.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: Ultra Spec 500 Interior.
 - d. Sheen:
 - 1) Walls: Eggshell, unless indicated otherwise.
 - 2) Ceilings: Flat, unless indicated otherwise.
 2. Sherwin Williams:
 - a. Primer: ProMar 200 Zero VOC Interior Latex Primer B28 Series.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: ProMar 200 Zero VOC Interior Latex.
 - d. Sheen:
 - 1) Walls: Eggshell, unless indicated otherwise.
 - 2) Ceilings: Flat, unless indicated otherwise.
 3. PPG:
 - a. Primer: Speedhide ZERO VOC Interior Latex Primer.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: Speedhide ZERO VOC Interior Latex.
 - d. Sheen:
 - 1) Walls: Eggshell, unless indicated otherwise.
 - 2) Ceilings: Flat, unless indicated otherwise.

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- B. Wood Trim, Wood Doors, Wood Frames and Other Interior Wood and Wood-Based Items as Indicated; Acrylic Latex. Provide one of the following systems:
1. Benjamin Moore:
 - a. Primer: Ultra Spec 500 Interior Latex Primer.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: Advance Waterborne Interior Alkyd.
 - d. Sheen: Semi-gloss, unless indicated otherwise.
 2. Sherwin Williams:
 - a. Primer: S-W PrepRite Multi-Purpose Latex Primer.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: Promar 200 WB Acrylic Alkyd.
 - d. Sheen: Semi-gloss, unless indicated otherwise.
 3. PPG:
 - a. Primer: Speedhide Interior Sealer Quick Drying 6-2.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: Speedhide Int/Ext Water Borne Alkyd.
 - d. Sheen: Semi-gloss, unless indicated otherwise.
- C. Ferrous and Non Ferrous Metals Including: Exposed metal fabrications, steel doors, steel door frames, grilles, panels, stairs, railings, and other miscellaneous metal items indicated; Direct to Metal Acrylic. Provide one of the following systems:
1. Rustoleum Sierra Performance:
 - a. Primer: S-37 System Metalmax DTM Acrylic Urethane.
 - b. Intermediate Coat: None required.
 - c. Top Coat: Same as Primer.
 - d. Sheen: Semi-gloss, unless indicated otherwise.
 2. Sherwin Williams:
 - a. Primer: Pro Industrial ProCryl Primer B66-1300.
 - b. Intermediate Coat: None required.
 - c. Top Coat: Pro Industrial Acrylic B66-1151 Series.
 - d. Sheen: Semi-gloss, unless indicated otherwise.
 3. PPG:
 - a. Primer: Pitt-Tech Plus EP PRIMER Int/Ext Rust Inhibitive Primer.
 - b. Intermediate Coat: None required.
 - c. Top Coat: 90-1610 Pitt-Tech Plus EP DTM Light Industrial.
 - d. Sheen: Semi-gloss, unless indicated otherwise.
- D. Concrete and Concrete Masonry; Acrylic Latex: Provide one of the following systems:
1. Benjamin Moore:
 - a. Primer:
 - 1) Concrete: Super Spec Masonry Interior/Exterior 100% Acrylic Masonry Sealer N/066.
 - 2) Concrete Masonry: Super Spec Latex Block Filler 160.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: Ultra Spec 500 Interior.
 - d. Sheen: Eggshell, unless indicated otherwise.

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2. Sherwin Williams:
 - a. Primer:
 - 1) Concrete: Loxon Concrete & Masonry Primer.
 - 2) Concrete Masonry: PrepRite Block Filler.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: ProMar 200 Zero VOC Eg-Shel, B20 Series.
 - d. Sheen: Eggshell, unless indicated otherwise.
 3. PPG:
 - a. Primer:
 - 1) Concrete: Perma-Crete Interior/Exterior Alkali Resistant Primer.
 - 2) Concrete Masonry: Speedhide Interior/Exterior Masonry Block Filler Latex 6-7 Series.
 - b. Intermediate Coat: Same as top coat.
 - c. Top Coat: Speedhide ZERO VOC Eggshell, 6-53XX Series.
 - d. Sheen: Eggshell, unless indicated otherwise.
- E. Mechanical And Electric Equipment Items: Insulated Piping Galvanized Ducts, Piping, Conduits, etc.; Provide one of the following systems:
1. Tnemec:
 - a. One Coat: Uni-Bond DF Series 115; 3.0 DFM.
 - b. Color: White.
 2. PPG:
 - a. One Coat: Speedhide Super Tech Interior Dry Fog Flat 6-723XI.
 - b. Color: White.

3.07 EXTERIOR PAINTING SCHEDULE

- A. Ferrous Metal: Exposed steel members, bollards, exposed miscellaneous metal; Urethane. Provide the following system:
1. Tnemec:
 - a. Primer: Zinc-rich polyurethane; Tneme-Zinc | 90G-1K97, 2.5 to 3.5 DFM.
 - b. Intermediate Coat: Polyamidoamine epoxy; Series L69 Hi-Build Epoxoline II, 4 to 6 DFM.
 - c. Top Coat: Aliphatic Acrylic Polyurethane; Series 1095 Endura-Shield, 2 to 5 DFM.
 - d. Sheen: Semi-gloss.
- B. Galvanized Metal: Exposed structural steel members, hollow metal doors and frames, railings, bollards, canopy framing, exposed miscellaneous metal; Urethane. Provide the following system:
1. Tnemec:
 - a. Primer: Polyamidoamine epoxy, Series L69, 4 to 6 DFM.
 - b. Intermediate Coat: Not required.
 - c. Top Coat: Aliphatic Acrylic Polyurethane; Series 1095 Endura-Shield; 2 to 5 DFM.
 - d. Sheen: Semi-gloss.

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- C. Concrete, Concrete Masonry, and Cement Plaster: Modified Waterborne Acrylate. Provide the following system:
1. Tnemec:
 - a. Primer: Waterborne modified polyamine epoxy, 151-1051 Elasto-Grip FC, 6 mils.
 - b. Intermediate Coat: Not required.
 - c. Top Coat: High build acrylic; Enviro-Crete; 9 DFM.
 - d. Sheen: Flat.
- D. Exterior Wood Siding and Trim; Acrylic latex. Provide one of the following systems:
1. Benjamin Moore:
 - a. Primer: Super Spec Busan Acrylic Exterior Primer.
 - b. Intermediate Coat: Same as topcoat.
 - c. Top Coat: Ultra Spec EXT.
 - d. Sheen: Satin.
 2. Sherwin Williams:
 - a. Primer: A-100 Exterior Latex Wood Primer.
 - b. Intermediate Coat: Same as topcoat.
 - c. Top Coat: A-100 Exterior Latex, 2 DFM.
 - d. Sheen: Satin.
 3. PPG:
 - a. Primer: 17-921 Seal-Grip Universal Int/Ext Primer Sealer.
 - b. Intermediate Coat: Same as topcoat.
 - c. Top Coat: Speedhide 6-2045XI 100% Acrylic Exterior Latex.
 - d. Sheen: Satin.
 - e. Fresh Start ® Multi-Purpose Latex Primer

END OF SECTION

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SECTION 09 96 00 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes surface preparation and the application of high-performance coating systems on the following substrates:
 - 1. Interior Substrates:
 - a. Concrete, horizontal surfaces.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples: For each type of coating system and in each color and gloss of topcoat indicated.

1.03 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each coating system.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Benjamin Moore & Co.
 - 2. PPG Architectural Finishes, Inc.
 - 3. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
 - 4. Sherwin-Williams Company (The).
 - 5. Tnemec Company, Inc.

2.02 HIGH-PERFORMANCE COATINGS, GENERAL

- A. Material Compatibility:

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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.
3. Products shall be of same manufacturer for each coat in a coating system.

B. Colors: Match Architect's samples.

PART 3 - EXECUTION

3.01 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.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating 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 coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible topcoats, primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

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3.03 APPLICATION

- A. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.04 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Horizontal Surfaces.

1. Epoxy System :
 - a. Prime Coat: Epoxy, matching topcoat.
 - b. Intermediate Coat: Epoxy, matching topcoat.
 - c. Topcoat: Epoxy, gloss.
 - 1) **<Insert manufacturer's name; product name or designation>**.
2. Pigmented Polyurethane System [MPI INT 3.2D]:
 - a. Prime Coat: Epoxy, gloss[, MPI #77].
 - 1) **<Insert manufacturer's name; product name or designation>**.
 - b. Intermediate Coat: Polyurethane, two component, pigmented, gloss, matching topcoat.
 - c. Topcoat: Polyurethane, two component, pigmented, gloss (MPI Gloss Level 6)[, MPI #72].
 - 1) **<Insert manufacturer's name; product name or designation>**.

END OF SECTION

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SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Fire-protection cabinets for the following:
 - a. Fire-hose valve.
- B. Related Sections:
 - 1. Division 21 Sections for fire-hose connections.

1.02 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-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
 - 2. Show location of knockouts for hose valves.
- B. Shop Drawings: For fire-protection cabinets.
 - 1. Include plans, elevations, sections, details, and attachments to other work.

1.03 COORDINATION

- A. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.02 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire existing hose, rack, and valve.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Cold-rolled steel sheet.
- D. Recessed Cabinet: Match existing.
- E. Door Style: Match existing.

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FIRE PROTECTION SPECIALTIES
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- F. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- G. 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: **[Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>**.
 2. Clear Float Glass: ASTM C1036, Type I, Class 1, Quality q3, **[3] [6]** mm thick.
 3. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, **[Class 1 (clear)] [Class 2 (tinted, heat absorbing, and light reducing), bronze tint]**.
 4. Tempered Break Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

2.03 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.

2.04 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.

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- 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

3.01 EXAMINATION

- A. Examine roughing-in for hose valves, racks, and cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.03 INSTALLATION

- A. 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 semirecessed 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.

3.04 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. 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.

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- D. 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

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SECTION 11 40 13 – FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Kitchen hood including fire suppression system.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 22 1000 - Plumbing.
 - a. Water supply piping and final connections to equipment.
3. Division 23 - HVAC.
 - a. Kitchen ventilation system.
4. Division 26 - Electrical.
 - a. Wiring and final connections to equipment and remote controls, including disconnect switches, etcetera, and conduits and pull boxes for refrigeration, and beverage lines.

1.02 PROJECT REQUIREMENTS

A. Design Requirements:

1. Provide adequate air supply and exhaust for self-contained refrigeration condensing units.
2. Install food service equipment, complete and in strict accordance with Construction Documents.
3. Kitchen hood shall be 100 percent exhaust hood type with integral fire suppression system, UL listed as an assembly. System shall be complete packaged type with components assembled by manufacturer. Features considered standard by manufacturer and which are required to complete the system, and to make it functional, obtain UL listing or comply with local code requirements shall be included without respect to specific detailing in this section.
4. Equipment shall be of a nature and so installed as to be readily cleanable or made easily removable for cleaning.
5. Furnish accessories and parts necessary to complete installation.
6. Coordinate work of this section with delivery and installation.
7. Anchor bolts, sleeves and other items required to be built into masonry and concrete will be set under other Sections and shall be furnished promptly so they may be built in as work progresses.

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8. Furnish embedded restraining devices, and fittings as required to secure equipment and fixtures, whether new or reinstalled.
 9. Work shall be designed and fabricated to suit field conditions and fitted with proper joints and intersections.
- B. Regulatory Requirements:
1. Whichever drawings, specifications or regulations require larger sizes or higher standards, the more stringent shall govern.
 2. Work and materials shall be in accordance with current editions of the following:
 - a. U.S. Public Health Service.
 - b. National Fire Protection Association.
 - c. Current National Sanitation Foundation standards.
 - 1) Ice maker shall be NSF listed.
 - 2) Custom fabricated items and equipment shall conform to current standards and revisions established by National Sanitation Foundation.
 - d. Equipment must comply with applicable safety and sanitary standards of any recognized testing agency certified by American National Standards Institute (ANSI).
 - e. Local or state ordinances regarding the use of steam.
 - f. Los Angeles County Department of Public Health.
 - g. State Accident Commission's Safety Orders.
 - h. CalOSHA.
 - i. Current Edition of CBC.
 - j. California Fire Code.
 - k. Environmental Protection Agency regulations.
 - l. State and local guidelines and regulations for seismic restraint of food service equipment and fixtures.
 - m. National Sanitation Foundation.
 - n. National Electrical Manufacturers Association.
 - o. Underwriters' Laboratories, Inc.
- C. Fees: Installer shall obtain and pay for the following:
1. Required permits and certificates of acceptance or of completion.
 2. Inspection certificates and licenses required and necessary for performance of Work. Post notices as required by code.

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3. Deliver certificates to OAR. OAR will withhold payment until necessary certificates are delivered.

1.03 SUBMITTALS

- A. Request for substitution must be made in accordance with Division 01.
- B. Provide mounting templates for equipment and fixtures requiring fasteners set into masonry or concrete.
- C. Rough-in Drawings: Prepare and submit separate electrical and mechanical dimensioned rough-in drawings at ¼-inch to 1 foot showing penetrations for services required (including refrigerant and beverage piping). Indicate locations and size of bases, openings in walls for equipment or operations, and critical dimensions.
- D. Shop drawings: Prepare and submit shop drawings for custom fabricated equipment or fixtures and refrigeration systems. Include the following information.
 1. Include large scale details of custom fabricated equipment.
 2. Sizes and locations of mechanical and electrical services.
 3. Curbs or other bases for custom fabricated items.
 4. Indicate sizes and location of anchor sleeves and other items required to be built into work.
 5. Include sizes and locations of mechanical and electrical services for OWNER furnished equipment to be relocated under this contract.
 6. Deviations from Construction Documents will only be allowed if approved in writing.
 7. Furnish six sets of submittal drawings.
- E. Product Data and Specifications Sheets: Furnish six sets of submitted equipment bound in binder and indexed. Each fixture shall be identified with an item number, accessories and finishes.
- F. Provide Shop Drawings of complete fire suppression system, including, location of tank and manual pull station and equipment and materials to be furnished, and approved by local fire authorities having jurisdiction. Approval by fire authorities may cover minimum legal requirements but does not supersede more restrictive requirements of the Contract Documents.

1.04 QUALITY ASSURANCE

- A. Inconsistencies between drawings and notes or code shall be resolved before commencing work.
- B. Field verify conditions at site before proceeding with work.
- C. Follow manufacturer's directions where installation is not indicated on drawings or specifications.

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- D. Dimensions indicated on drawings have been secured from best available information. Field verify dimensions.
- E. Allow space for fittings.
- F. Installer shall make final connections.
- G. Submit certification from refrigerator-freezer manufacturer stating that the installers for this project are certified by them for this type of installation.

1.05 EQUIPMENT LIST APPROVAL

- A. In order to establish a standard of quality, equipment listed is specified from the indicated manufacturer.
- B. OWNER's Food Services Branch will establish equivalency and compliance of product or components offered for installation under this Contract.
- C. When drawings are submitted for installation, their approval shall not waive requirements indicated in construction documents.

1.06 OPERATING INSTRUCTIONS AND MANUALS

- A. Furnish three copies of bound "Operating Instructions and Service Manual" to OAR upon substantial completion of work. Incorporate complete information, including but not limited to following:
 - 1. Part numbers of replaceable items.
 - 2. Manufacturer's cuts and rating tables.
 - 3. Oiling, lubrication and greasing data.
 - 4. Belt sizes, types and lengths.
 - 5. Serial numbers of principal pieces of equipment.
 - 6. Installing and service representatives companies, names, addresses, and phone, e-mail and FAX numbers.

1.07 PRODUCT HANDLING

- A. Deliver equipment to project site new condition, free from defects or damage. Rejected items shall be removed from project and replaced without additional cost to OWNER.
- B. If equipment is too large to be moved through permanent openings in building, Installer shall make arrangements to have suitable temporary openings provided at his expense, or he shall furnish his equipment in sub-assemblies which may be moved through permanent openings and then assembled.
- C. Installer shall make provision (and pay storage fees) for items delivered to job site before and during installation. If receipt and storage cannot be arranged, items must be received and accounted for by Installer.

1.08 COORDINATION

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- A. Verify size and position of duct work and connections for hoods before fabrication.
- B. Where flatware dispensers are specified, verify dimensions and weight before placing orders with manufacturers.
- C. Lengths between walls for custom fabricated fixtures, and also ceiling heights, shall be field verified.

1.09 SERVICE

- A. Food service equipment and fixtures shall be supported by a service organization reasonably convenient to site that will assure service will be performed within twenty-four hours of service request.
- B. Manufacturer, or his agent shall maintain an adequate stock of repair parts which shall be available for immediate, local delivery.

1.10 WARRANTY

- A. Unless otherwise specified under item number, Warranty shall be Manufacturer's standard.
- B. Self-Contained Refrigeration Equipment:
 - 1. One year, after date of substantial completion, service and maintenance contract for parts and installation.
 - 2. Five years warranty on parts, except when otherwise specified.

PART 2 - PRODUCTS

2.01 FOOD SERVICE EQUIPMENT LIST

- A. Provide all standard accessories unless specified otherwise, and provide all options called out.

ITEM NO. 1: KITCHEN HOOD WITH FIRE SUPPRESSION SYSTEM,
refer to 2.03 AND 2.04.

2.02 MATERIALS GENERAL

- A. Switches, Controls and Electrical Work:
 - 1. Each motor driven appliance or electrically heated unit shall be provided with a suitable control switch or starter in accordance with U.L. requirements.
 - 2. Other fittings, and connections shall be furnished and installed in compliance with Division 26.
 - 3. Provide internally wired equipment with a junction box, push button switches, starters, and other apparatus, built into or forming an integral part of these items. Provide materials and labor for a complete

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electrical installation in compliance with applicable codes and industry standards.

4. Walk-in refrigerators and freezers shall be equipped with door operated switches with pilot lights.
 5. Provide standard three-prong plugs to fit "U" slot grounding type receptacles for equipment items powered by 110-120 volts, single phase current, with suitable length three-wire power cord.
- B. Convenience Outlets:
1. Provide custom fabricated fixtures with properly sized cut-outs for power receptacles. Electrical boxes shall be mounted at locations indicated on the drawings.
- C. Electric Motors and Starters:
1. Adjust or replace equipment producing objectionable noise.
 2. Motors larger than 1/4 horsepower, but less than 1/2 horsepower:
 - a. Motors smaller than 1/2 HP shall be 120 volts, 60 cycles, single phase.
 - b. Equip motor starter with overload protection.
 - c. If starters are not standard part of the equipment, deliver starters to job site separately for installation under Electrical Work.
 - d. Automatic starters shall be General Electric #CCF7006, or equal. Push button station shall be included.
 3. Motors 1/2 HP and larger:
 - a. Unless otherwise indicated, 1/2 HP or larger motors shall be 208 volts, 60 cycles, 3-phase, or 480 volts, 60 cycles, 3-phase.
 - b. Motors not having automatic operation starters shall be supplied with General Electric #CR062 starters, or equal.
 4. Motors under 1/2 HP and not having automatic operation shall be provided with a General Electric #CR1061 starters or equal.
 - a. Starter shall be enclosed and surface mounted type.
 - b. 120 volt motors shall have single pole starters.
 - c. 208 and 408 volts, 3-phase motors shall have 3-pole starters.
- D. Connection Terminals: equipment shall be furnished complete with standard connection terminals.
- E. Thermometers: Refrigerated equipment shall be fitted with digital read out thermometers, or dial type thermometers with chrome plated bezels, as required by NSF. Thermometers shall be adjustable and shall be calibrated after installation.
- F. Trim and Seal:

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1. Space between units to walls, ceilings, floors, and adjoining units not portable and with enclosed bodies shall be completely sealed against entrance of food particles and vermin by means of trim strips, welding, soldering, or commercial joint material as suited to equipment.
 2. Ends of hollow sections shall be closed.
 3. Enclosed fixtures without legs and not mounted on bases shall be sealed water-tight to floor, except when specified to be portable.
 4. Provide floor type drip pans and expansion joint material for sealing pan edges to finish floor.
 - a. Joint sealing materials shall be two-part sealing compound "Weatherban" as manufactured by 3M.
 - b. Color shall match floor grout.
 - c. Install sealer according to manufacturer's instructions.
- G. Locks: Provide doors of refrigerated compartments with cylinder locking type latches, keyed and master keyed to building standards.

2.03 KITCHEN HOODS

- A. Hoods shall be as manufactured by CaptiveAire, Duo-Aire, Gaylord, Greenheck, or equal.
- B. Kitchen hoods shall be UL listed Type I of the UMC standard, integrated with make-up air supply and exhaust fans, and fire suppression system. Fabrication of system components shall be in accordance with NFPA 96 requirements and bear the NSF seal. Unit shall be complete with UL labeled fusible link fire damper.
- C. Kitchen hood shall be 18 gage stainless steel Type 304. Totally welded construction complete with stiffeners and reinforcements, seams and joints ground down and highly polished to a # 4 finish. Exhaust plenum, completely separated from supply air shell to create 2 chambers (exhaust and supply) with both openings on top of hood. Make-up air shall be supplied through hood's face panel into the kitchen occupied space under controlled balanced condition. The hood's exhaust system shall permit a velocity at hood's face area of not less than 50 to 80 fpm when hood is installed against wall and 100 to 125 fpm when hood is installed over island cooking area. Hood shall be installed as indicated on the Drawings. Vapor-proof lights shall be installed on 3-foot or 4-foot centers, completely wired and ready for external power source.
- D. Grease filters shall be provided with appropriate filter banks. Provide filter with optimum grease removal efficiency. Filters shall be fire retardant per NFPA 96. Filters shall be stainless steel grease extractor type as manufactured by Fire Fighter, Flame Gard, Fire Chief, or Greenheck.
- E. Control panels shall be remote, flush-mounted type and shall be furnished with one switch for exhaust fan and make-up air unit, one switch for hood lights and indicator light for exhaust fan. Control panel shall be mounted on a wall.

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F. Kitchen Hood Ducts: Refer to Section 23 3813, Kitchen Ventilation System.

2.04 KITCHEN HOOD FIRE SUPPRESSION SYSTEM

- A. Kitchen hood shall be provided with a UL listed fire suppression system. System shall be furnished with liquid fire-suppressant, regulated release assembly discharge nozzles, detection components, remote manual pull station, piping and controls. System shall be ANSUL R-102, or equal.
- B. Fire suppression system shall be capable of automatic detection and actuation with local or remote manual actuation. Electrical power to electric cooking appliances, convection ovens and lights under hood shall be shut off when system is actuated.
- C. System shall protect exhaust hood, exhaust plenum, exhaust duct, grease filters, and grease producing surfaces.
- D. Installation shall be by manufacturer approved personnel in accordance with Manufacturer's printed guidelines. System shall include required components for a complete, operating, fire suppression system:
 - 1. Piping. Exposed piping and fittings shall be chrome plated.
 - 2. Where possible conduits shall be concealed within walls.
 - 3. Pull boxes shall be flush mounted.
 - 4. Regulator actuator assemblies.
 - 5. Discharge nozzles.
 - 6. Remote manual pull stations.
 - 7. Agent tanks.
 - 8. Wet chemical agent.
 - 9. Obstruction of ventilator constitutes an impingement under NFPA Pamphlet 13. Protect area as required.
- E. Testing: Installer shall perform required testing in presence of IOR.
 - 1. Installer shall be responsible for securing permits required.
 - 2. After completion of installation installer shall obtain certifications from fire protection authorities that system conforms to NFPA Pamphlets 17A and 19, and UL Listing.
 - 3. Installer shall submit a certificate of completed product liability insurance of no less than \$500,000.

PART 3 - INSTALLATION

3.01 GENERAL

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- A. Food service equipment shall be installed strictly in accordance with approved shop drawings and manufacturers' instructions.
 - B. Installation of cooking equipment shall comply with applicable codes, for each type, of equipment indicated. Compliance with installation requirements shall be sole responsibility of Installer.
 - C. Install equipment level, and securely fasten fixed equipment in place.
- 3.02 OPERATIONAL TESTS AND INSPECTION
- A. Request facility inspection by Environmental Health authorities and other jurisdictions responsible.
 - B. Prior to Substantial Completion, operate and test refrigerator and freezer equipment and systems for at least 14 consecutive days to demonstrate satisfactory operation as a completed unit.
 - 1. Notify Project Inspector at least three days in advance of start of testing.
 - 2. Tests shall commence after preliminary balancing and adjustments to equipment and systems to ensure proper operating condition.
 - 3. Repair or replace defective work.
- 3.03 SEISMIC RESTRAINTS FOR EQUIPMENT AND FIXTURES
- A. Fixed equipment and fixtures shall be anchored and secured to structural members according to requirements current CBC.
- 3.04 FINAL CLEANING
- A. Clean, sanitize and have ready for operation food service equipment and fixtures at time of Environmental Health inspections and at time of turn over of facility to OWNER.
- 3.05 CLEAN UP
- A. Remove debris and rubbish from premises and legally disposed of.
 - B. Equipment shall be clean and ready for use when turned over to OWNER.
 - 1. Protection of completed and cleaned work shall be responsibility of Kitchen Equipment Supplier.
 - 2. Include existing-reset equipment as listed in specifications.
- 3.06 ADJUSTMENT OF EQUIPMENT AND DEMONSTRATION
- A. Equipment shall be tested for leaks, poor connections, inadequate or faulty performance. Adjust and correct, if necessary; proper operation.
 - 1. Thermostatically controlled equipment and equipment with automatic features shall be operated for 14 days to prove controls are functioning as intended. Walk-in refrigerators and freezers shall be turned on and ran for a minimum of fourteen days.

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- B. At a time and date, as selected by OWNER, Supplier shall demonstrate equipment for OWNER. Demonstrations shall be conducted by factory trained engineers of various equipment manufacturers and shall be done in two stages: First demonstration shall be for Operations Branch representative. Second for Maintenance personnel. A representative of Kitchen Equipment Supplier must be in attendance at both demonstrations.
- C. Refrigeration equipment shall be run as a minimum of three days duration before acceptance.

END OF SECTION

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SECTION 11 66 23 - GYMNASIUM EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Safety pads.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of gymnasium equipment.

1.03 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gymnasium equipment to include in operation and maintenance manuals.

1.04 FIELD CONDITIONS

- A. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.

1.05 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SAFETY PADS

- 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. Insert manufacturer's name.
- B. Source Limitations: Obtain from single source from single manufacturer.
- C. 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.

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- D. 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[, **and lined with fire-retardant liner**].
- E. 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: Minimum 3/8-inch- thick [**plywood, mat formed, or composite panel**] [**fire-retardant-treated plywood by pressure process according to AWPA U1, Use Category UCFA Fire Retardant Interior**].
 2. Fill: Multiple-impact-resistant foam, minimum [1-1/2-inch- **thick polyurethane, 3.5-lb/cu. ft. density**] [2-inch- **thick polyurethane, 3.5-lb/cu. ft. density**] [1-1/2-inch- **thick bonded polyurethane, 6.0-lb/cu. ft. density**] [2-inch- **thick bonded polyurethane, 6.0-lb/cu. ft. density**] [1-1/4-inch- **thick, closed-cell polyethylene**] <Insert material, thickness, and density>.
 3. Fire-Resistive Fill: Multiple-impact-resistant foam minimum [1-1/2-inch- **thick, fire-resistive neoprene, 6.0-lb/cu. ft. density**] [2-inch- **thick, fire-resistive neoprene, 6.0-lb/cu. ft. density**].
 4. Size: Each panel section [24 inches **wide by minimum 60 inches long**] [24 inches **wide by minimum 72 inches long**] [of manufacturer's standard dimensions] [as indicated on Drawings] <Insert dimension(s)>.
 5. Number of Modular Panel Sections: [As indicated on Drawings] <Insert number>.
 6. Installation Method: [**Concealed mounting Z-clips**] [**Concealed mounting Z-clips and 1-inch bottom fabric attachment flange with exposed fasteners**] [1-inch **top and bottom fabric attachment flange with exposed fasteners**] [**Manufacturer's standard**] <Insert requirement>.
 7. Fabric Covering Color(s): [**Match school colors**] [As indicated by manufacturer's designations] [**Match Architect's sample**] [As selected by Architect from manufacturer's full range] for [one] [two] <Insert number> color(s).
 8. Graphics: Custom graphics as indicated on Drawings.
- F. Corner Wall Safety Pads: Wall corner pad consisting of minimum 1-1/4-inch- thick, multiple-impact-resistant, closed-cell, polyethylene-foam filler, covered on both sides and all edges by fabric covering with [**backer board and manufacturer's standard anchorage to wall**] [**self-adhesive, hook-and-loop attachment to exposed face of wall**].
1. Length: Each pad [minimum 72 inches] [**in manufacturer's standard length**] [**matching length of wall safety pads**] [as indicated on Drawings] <Insert requirement>.

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2. Fabric Covering Color(s): **[Match color of wall safety pads] [Match school colors] [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range]** for **[one] [two] <Insert number>** color(s).
- G. Column Safety Pads: Pads covering exposed flange of columns to height indicated, consisting of minimum 1-1/4-inch- thick, multiple-impact-resistant, closed-cell, polyethylene-foam filler, covered on both sides and all edges by fabric covering with **[backer board and manufacturer's standard anchorage to column] [self-adhesive, hook-and-loop attachment to exposed face of column]**.
1. Length: Each pad **[minimum 72 inches] [in manufacturer's standard length] [matching length of wall safety pads] [as indicated on Drawings] <Insert requirement>**.
 2. Fabric Covering Color(s): **[Match color of wall safety pads] [Match school colors] [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range]** for **[one] [two] <Insert number>** color(s).
- H. Round Column Safety Pads: Wraparound pads **[fully] [partially]** covering exposed round column to height indicated, consisting of minimum 2-inch- thick, multiple-impact-resistant, bonded polyurethane-foam filler, 6.0-lb/cu. ft. density, covered on both sides and all edges by fabric covering with **[hook-and-loop] [cord lace and grommet]** attachment to column.
1. Length: Each pad **[minimum 72 inches] [in manufacturer's standard length] [matching length of wall safety pads] [as indicated on Drawings] <Insert requirement>**.
 2. Fabric Covering Color(s): **[Match color of wall safety pads] [Match school colors] [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range]** for **[one] [two] <Insert number>** color(s).
- I. Cutout Trim: Manufacturer's standard flanged cutout trim kits for fitting pads around switches, receptacles, and other obstructions.
1. Color: **[Gray] [Black]**.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions.

3.02 INSTALLATION OF SAFETY PADS

- A. Mount with bottom edge at **[4 inches] [dimension indicated on Drawings] <Insert dimension>** above finished floor.

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GYMNASIUM EQUIPMENT
11 66 23 - 3

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- B. Cutout Trim: Limit cuts in face of padding so that cuts are securely and fully concealed behind trim-kit flange.

END OF SECTION

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SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section provides the basic plumbing requirements that apply to the Work of Division 22.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 22: Plumbing
3. Division 23: HVAC
4. Division 26: Electrical.

1.02 REGULATORY REQUIREMENTS

- A. Current federal Safe Drinking Water Act (SDWA) regulations require the furnishing of lead-free pipe, solder, and flux in the installation or repair of plumbing in non-residential facilities connected to public drinking water systems. Under this regulation, solders and flux are considered lead-free when they contain 0.2 percent lead or less. Under California regulations pipes and pipe fittings are considered lead-free when they contain 0.25 percent lead or less as defined in California Assembly Bill 1953 (AB 1953). No pipe, pipe fittings, or any other fitting or fixture intended to convey or dispense water for human consumption by drinking or cooking is allowed in the domestic plumbing system, if they do not meet the low lead definition of AB 1953. Weighted average lead content of the wetted surface area of pipes, fittings and fixtures may not exceed 0.25 percent.

1. Provide lead-free water pipe, solder, and flux materials that meet the standards as outlined by the federal SDWA regulations and California AB 1953 if installed in drinking water system.
2. Collect pipe, solder, and flux material samples as required by the Project Inspector. Test samples shall be delivered to an Owner designated testing laboratory for testing of lead content.
 - a. Test samples for lead content by the atomic absorption spectrophotometry method.

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3. Materials found not conforming to SDWA and California AB 1953 regulations shall be deemed defective Work and shall be replaced with lead-free materials.
 4. Comprehensive testing of the remaining materials for their lead content shall be performed as required by the Project INSPECTOR.
- A. Materials, fabrication, equipment, and installation shall comply with industry standards and code requirements. Where manufacturer's recommendations exceed industry standards, the manufacturer's recommendation shall establish the minimum standard. As a minimum, standards from the following organizations shall apply:
1. ANSI - American National Standards Institute.
 2. ASME - American Society of Mechanical Engineers.
 - a. ASME Boiler and Pressure Vessel Code.
 - b. ASME B31 - Standards for Pressure Piping.
 3. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers.
 4. ASTM - American Society for Testing and Materials.
 - a. ASTM A53 Specification for Welded and Seamless Pipe.
 5. AWWA - American Water Works Association.
 6. CSA - Canadian Standards Association.
 7. FM Global - Factory Mutual Global
 8. IAPMO - International Association of Plumbing and Mechanical Officials.
 9. NFPA - National Fire Protection Association.
 10. OSHA - Occupational Safety and Health Administration.
 11. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association.
 12. UL - Underwriters Laboratories Inc.
 13. Intertek (ETL Certification).
- B. Materials, fabrication, equipment, and installation shall comply with federal, state, and local codes including, but not limited to, the following:
1. CBC, California Building Code, and CMC, California Plumbing Code.
 - a. Latest edition as adopted by the City of Canyon Country, the County of Ventura, and the State of California including amendments effective on the Effective Date of the Contract.
 2. California Code of Regulations, Title 8, Industrial Relations, Division 1, Chapter 4, Division of Industrial Safety.
 3. OSHA - Occupational Safety and Health Administration.
 4. CDPH - California Department of Public Health.

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- 5. SCAQMD - South Coast Air Quality Management District.
- C. Specifications or Drawings shall not be construed to permit deviation from the requirements of governing codes unless approval has been obtained from legally constituted authorities having jurisdiction, and the Architect. The Contract Documents may contain more stringent requirements than those legally required.
- D. Permits and Fees: Refer to the General and Supplementary Conditions.

1.03 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00: Submittal Procedures and with specific requirements of Division 22 sections, as applicable.
- B. The above information shall become the basis for inspecting and testing materials and actual installation procedures performed in the Work.
- C. Shop Drawings: Submit one additional copy when control diagrams having line voltage connections are indicated. Shop Drawings shall be specifically prepared for the Work of this Project. Drawings prepared in accordance with requirements of Section 01 31 13: Project Coordination and Section 01 33 00 may be provided by the Architect to serve as a background for the Shop Drawings. Shop Drawings shall comply with the requirements of Section 01 31 13 and Section 01 33 00 and shall indicate at a minimum:
 - 1. Complete system layout of equipment, components, plumbing fixtures, piping, indicating service clearances, and pipe sizes, fitting types and sizes and pipe elevations, distances of pipes and equipment from building reference points and hanger support locations. The above items shall be coordinated on the shop drawings according to the requirements of Section 01 31 13.
 - 2. Schedule and description of equipment, piping and fittings.

1.04 PROJECT RECORD DOCUMENTS

- A. Comply with provisions of Section 01 77 00: Contract Closeout.
- B. Project Record Drawings:
 - 1. Provide a complete set of plumbing and fire protection drawings in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks and plotter pen color/line thickness settings on CD-ROM. Also submit one set of full size reproducible plots on vellum and 3 sets of prints.
 - 2. Before Contract Completion, deliver corrected and completed prints to the OAR. Delivery of project record documents to the OAR does not relinquish

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responsibility of furnishing required information omitted from project record documents.

C. Operation and Maintenance Manuals:

1. Submit two copies of operation and maintenance manuals in required form and content. If no revisions are required, furnish one additional copy. If revisions are required, one copy shall be returned with instructions for changes; perform such changes and return three copies of manuals. Manuals shall be bound in accordance to Section 01 77 00. Deliver manuals to the OAR. Submit an electronic copy of the entire manual in PDF file format.
2. Contents of Manual:
 - a. Title sheet with Project name, including names, addresses and telephone number of Contractor, installer, and related equipment suppliers.
 - b. Manufacturer's operating instructions including, but not limited to, the following:
 - 1) Identification of components and controls.
 - 2) Trouble shooting checklist and guidelines.
 - 3) Recommendations for optimum performance.
 - 4) Warnings and safety precautions on improper or hazardous operational procedures or conditions
 - c. Manufacturer's product data and parts and maintenance booklet for each item of equipment furnished under Division 22 that includes the following as a minimum:
 - 1) Manufacturer's model, identification and serial numbers.
 - 2) Exploded view of assembly drawings identifying each component or part with the relevant part number.
 - 3) Directory of manufacturer's representatives, service contractors and part distributors.
 - 4) Maintenance and trouble-shooting instructions, including schedule for preventive maintenance, periodic inspection and cleaning criteria.
 - d. Project Record Drawings: Complete set of plumbing, fire protection and control system drawings in 50 percent reduced print format shall be furnished with the manual. Submit the above record drawings on CD-ROM in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks, and plotter pen color/line thickness settings.
 - e. Testing, Adjusting, and Balancing reports: Submit to architect.

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- f. South Coast Air Quality Management District (SCAQMD) permits to install and operate boilers, water heaters and other fuel burning equipment and third-party source test reports as required by SCAQMD to allow start-up and operation of equipment.
- g. Ventura County industrial waste permits.
- h. Valve directories complete with location, function, size, and model of each valve with reference to the project record drawings.
- i. Equipment and component identification chart complete with location, function, size, and model of each equipment or component with reference to the project record drawings.

1.05 COORDINATION

- A. Contract Documents indicate extent and general arrangement of Work under Division 22. Contractor shall coordinate work in accordance with Section 01 31 13 requirements and make adjustments as required to provide maximum headroom, a neat arrangement to keep passageways and openings clear to provide accessibility and provisions for maintenance, and to meet code requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Deliver materials to Project site in their original unopened containers with labels intact and legible at time of delivery. Store in strict accordance with manufacturer's recommendations.
- B. Do not store plastic pipe or materials in direct sunlight.

1.07 PRELIMINARY OPERATION

- A. OAR may require any portion of plumbing Work to be operated before Substantial Completion. Such operation shall be in addition to regular tests, demonstrations and instructions required under the Contract Documents, and shall be performed as required.
- B. Notify the INSPECTOR at least 24 hours in advance of lighting or re-lighting pilots.

1.08 TRAINING OF OWNER PERSONNEL

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- A. Training of Owner's personnel shall include:
 - 1. A minimum of 4 hours of on-site overview of the overall Plumbing System.
 - 2. Refer to Division 22 sections for specific training on each of the components of the Plumbing System.
- B. Contract shall include the cost of training Owner operation and maintenance personnel in operating, adjusting, maintenance, trouble-shooting, and Project site repair of each component, equipment, or system provided under this Contract.
- C. Operational and maintenance training shall be conducted on the Project site, unless indicated otherwise.
- D. Upon completion of Owner training, a completion certificate indicating the nature of the training and a description of the systems, complete with equipment and component lists shall be issued to each trainee. The certificate should be issued in duplicate with one copy retained by OAR.
- E. An attendance sheet with the names and signatures of all participants attending the training shall be submitted to the OAR and kept as part of the project documents.

1.09 GUARANTEES AND DAMAGE RESPONSIBILITY

- A. Sound of water flowing in piping shall not be transmitted to building structure. Operation of mechanical system shall not produce operational sounds that can be heard outside of rooms enclosing apparatus or equipment.

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Unless otherwise specified, materials and equipment shall be new, in good and clean condition. Equipment, materials, and components shall be of the make; type and model number noted on Drawings or specified. Pieces of equipment of the same type shall be by the same manufacturer.
- B. Whenever an item is listed by a single proprietary name, with or without model number and type, it shall be for purpose of design only, to indicate characteristics and quality desired. Proprietary designation listed on Drawings, or listed first in Specifications, is used as a basis for design to establish a standard for quality and performance and space requirements.
- C. Equipment and materials indicated or required to be installed outdoors shall be of the type that is designed, manufactured, listed or approved by authorities having jurisdiction for outdoor installation by being resistant to the adverse effects of weather.

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The additional protective measures against outdoor weather required by the manufacturers' installation instructions and prevalent practice shall be provided.

- D. For substitution of materials or products, refer to the General Conditions.

PART 3 – EXECUTION

3.01 SERVICE INTERRUPTIONS, OFF-SITE, GAS AND WATER

- A. Schedule Work so there shall be no service interruptions of existing systems or systems during normal hours of operation of affected systems and facilities.
- B. When service interruptions are mandatory, arrange in advance with the OAR as to time and date of such interruptions.
- C. Systems, which are interrupted, shall be returned back into operation in such manner that they will function as originally intended.

3.02 CUTTING, NOTCHING, AND BACKING

- A. Conform to California Building Code, Title 24, Part 2, for notches and bored holes in wood and for pipes and sleeves embedded in concrete and for cuts in steel, as detailed on structural Drawings.
- B. Where pipes pass through, or are located within one inch of any construction element, install a resilient pad, ½ inch thick minimum, to prevent contact.
- C. Furnish provisions for recesses, chases, and accesses and provide blocking and backing for proper reception and installation of plumbing Work.

3.03 LOCATION OF PIPING AND EQUIPMENT

- A. Location of piping, apparatus and equipment indicated on the Drawings is approximate and shall be altered to avoid obstructions, preserve headroom, and provide free and clear openings and passageways.
- B. Trenches parallel to footings shall not be closer than 18 inches to the face of footings and shall not be below a plane having a downward slope of 2 horizontal to one vertical, from a line 9 inches above bottom of footing.
- C. Pipe in tunnels shall be installed close to one side of tunnel to provide maximum space for passage. Pipe shall not be installed through crawl hole unless otherwise specified or detailed on Drawings.

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- D. Place equipment in locations and spaces indicated, disassemble and/or reassemble equipment as required by Project conditions.

3.04 TESTS AND TESTING

- A. Tests shall be as required under the applicable sections of Division 22, including this Section.
- B. Additional tests may be required in the case of products, materials, and equipment if:
 - 1. Submitted items are altered, changed, or cannot be determined as exactly conforming to the Contract Documents.
 - 2. Performance testing and results may also be required on certain items which are as specified, including fan, and pump performance.
- C. Piping Tests:
 - 1. Perform tests required to demonstrate that operation of plumbing systems and their parts are in accordance with Specifications covering each item or system, and furnish materials, instruments and equipment necessary to conduct such tests. Tests shall be performed in presence of the Inspector, and representatives of any governmental agency having jurisdiction. Work shall not be concealed or covered until required results are provided.
 - 2. If required tests are not performed, Owner may provide in accordance with the Contract Documents.
 - 3. Pressure gauges furnished in testing shall comply with CPC. Air shall be bled from lines requiring hydrostatic or water tests.
 - 4. Systems shall be pressure-tested in accordance with pipe testing schedule below. Pipe test shall indicate no loss in pressure after a minimum duration of 4 hours at test pressures indicated. Where local codes require higher test pressures than specified herein for fire sprinkler systems, local codes shall govern.
 - 5. Fuel gas lines shall be first tested with piping exposed, before backfilling trenches or lathing; second with piping in finished arrangement, backfilled and paved where required, and walls finished.
 - 6. Piping systems may be tested as a unit or in sections, but entire system shall successfully meet requirements specified herein, before final testing by the Inspector.
 - 7. Repair of damage to pipes and their appurtenances or to any other structures resulting from or caused by these tests, shall be provided.

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D. Pipe Testing Schedule:

System Tested	Test Pressure (psig)	Test With:
Roof drain (except pipes running under a slab or underground)	Fill with water to top of highest vent; allow to stand two hours, or longer, as required by Inspector. Minimum head required for any joint shall be 10 feet in building.	Water
Cast-iron soil, waste and interior downspout, condensate drain from air conditioning equipment	10 feet of water, vertically	
Storm water disposal lines	Running water test	Water
Domestic water piping	200	Water
Fire sprinkler piping	200	Water

E. Equipment Performance Assurance Tests:

1. Before operating any equipment or systems, a thorough check shall be performed to determine that systems have been flushed and cleaned as required and that equipment has been properly installed, aligned, lubricated, and serviced. Factory instructions shall be checked to verify installations have been completed and recommended lubricants have been installed in bearings, gearboxes, crankcases, and similar equipment. Particular care shall be furnished in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Equipment shall also be checked for damage that may have occurred during shipment, after delivery, or during installation. Damaged equipment, products, and materials shall be replaced or repaired as required.
2. Upon completion of the above, adjust the system settings to within normal operating conditions to prevent the system from being damaged upon start-up.
3. Run-test the equipment after start-up for five consecutive days. Tests shall include operation of all equipment and systems for a period of not less than two 8 hour periods at 90 percent of the full specified capacities.
4. Equipment Start-up Reports: For each equipment or system on which start-up is performed, submit 8 copies of start-up report for review by the Architect.
 - a. The start-up report shall include the manufacturer's standard start-up form completed and signed by the start-up technician.
5. Provide, maintain, and pay costs for equipment, instruments, and operating personnel as required for specified tests.
6. Provide electric energy and fuel required for tests.
7. Final adjustment to equipment or systems shall meet specified performance requirements.

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8. Equipment, systems, or Work deemed defective during testing shall be replaced or corrected as required. Test until satisfactory results are provided.
- F. Specific Coordinated Plan for Test and Balance:
1. Provide a narrative of the operational intent that clearly describes the function and sequence of operation of each component, equipment, or system installed. Instruct designated Owner personnel in the operation of the installed systems.
 2. Prior to final test and balance, plumbing equipment and systems shall be operated and tested as indicated in Article 3.04.F above to demonstrate satisfactory overall operation of the installed systems.
 3. Welding performed as part of this Division may be subject to radiographic inspections at random in accordance with requirements specified in Section 22 05 13: Basic Plumbing Materials and Methods.

3.05 NOISE AND VIBRATION REDUCTION

- A. Correct noise or vibration caused by plumbing systems. Provide all necessary adjustments to specified and installed equipment and accessories to reduce noise to the lowest possible level
- B. Correct noise or vibration problems caused by failure to install work in accordance with Contract Documents. Include all labor and materials required as a result of such failure. Pay for re-testing of corrected noise or vibration problems by the project acoustical consultant including travel, lodging, test equipment expenses, etc.

3.06 PROTECTION, CARE AND CLEANING

- A. In addition to storage criteria of the General Conditions, and provisions under Section 01 50 00: Construction Facilities and Temporary Controls, the following shall be provided:
 1. Provide for the safety and good condition of materials and equipment until Substantial Completion. Protect materials and equipment from damage.
 2. Protect installed Work.
 3. Replacements: In case of damage, immediately provide repairs and/or replacements as required.
 4. Protect covering for bearings, open connections to tanks, pumps, compressors and similar equipment.
 5. Interior of piping shall be maintained free of dirt, grit, dust, and other foreign materials.
 6. Fixtures, piping, finished brass or bronze, and equipment shall have grease, adhesive, labels, and foreign materials removed. Chromium, nickel plate, polished bronze or brass Work shall be polished. Glass shall be cleaned inside and out.

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7. Before initial start-up and again before Substantial Completion, piping shall be drained and flushed to completely remove grease and foreign matter. Pressure regulating assemblies, traps, strainers, boilers, flush valves, and similar items shall be thoroughly cleaned. Tag system with an information tag listing responsible party and date of element, before initial start-up and again before Substantial Completion. Compressed air, oil, and gas piping shall be blown out with oil-free compressed air or inert gas.

END OF SECTION

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SECTION 22 05 13 - BASIC PLUMBING MATERIALS AND METHODS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. This Section prescribes basic materials and methods generally common to the Work of Division 22.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Division 22: Plumbing.
 - 3. Division 23: HVAC.
 - 4. Division 26: Electrical.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01, Section 22 05 00 and specific requirements of each section of Division 22.
- B. Types of welding rods to be used.

1.03 QUALITY ASSURANCE

- A. Standards: Comply with applicable national, state, and local codes and standards: ASTM, ASME, and ANSI. Federal Specifications, AWWA, SISPI, NFPA, FM, UL, CPC (California Plumbing Code), CMC (California Plumbing Code), CSA.
- B. Conform to provisions of Section 22 05 00: Common Work Results for Plumbing.
- C. Manufacturer of plumbing products must be third-party certified to ANSI/NSF Standard 61, Section 9 certification, and ANSI/NSF 372 to demonstrate compliance with the federal requirements for lead contribution to drinking water, the Safe Drinking Water Act SDWA, and the California Health and Safety Code Section 116875.
- D. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the ARCHITECT.

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1.04 COORDINATION

- A. Coordinate related Work in accordance with provisions of Section 01 31 13: Project Coordination.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Provide the following products if they are indicated in the Contract Documents or if they are required for the proper installation, function or operation of equipment, systems or components indicated in the Contract Document.
- B. Provide the following products as a complete assembly with required accessories for a complete and functioning entity in compliance with governing codes and applicable standards as specified in Section 22 05 00, manufacturer's instructions or as required.
 - 1. Omission of minor details in the Contract Documents does not waive and/or otherwise relinquish compliance with the above requirements.

2.02 MANUFACTURERS AND MATERIALS

- A. Ball Valves: 2-inch and smaller:

BV-1: Class 150, 600 psi, Bronze, CWP two piece construction with reinforced TFE seats, full port, adjustable packing gland, (no threaded stem designs allowed), threaded or solder ends.

Manufacturer: Apollo Valves 77CLF-100A/77CLF-200A, NIBCO T-685-66-LF/S-685-66-LF, Hammond UP8303A/UP8513, Milwaukee UPBA400S/ UPBA450S, or equal.

BV-2: Class 150, 600 psi, Stainless Steel, CWP two piece construction with reinforced TFE seats, full port, adjustable packing gland, (no threaded stem designs allowed), threaded or solder ends.

Manufacturer: Apollo Valves 76F-100, NIBCO T-585-S6-R-66-LL, Milwaukee BA260, or equal.

Ball Valves in Insulated Piping: Use extended operating handle of non-thermal conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied. Apollo Valves Therma-Seal, NIBCO Nib-Seal Handle.

- B. Butterfly Valves:

BUTTERFLY VALVES IN A DOMESTIC PLUMBING SYSTEM INTENDED TO

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CONVEY WATER FOR HUMAN CONSUMPTION SHALL COMPLY WITH QUALITY ASSURANCE, ARTICLE 1.03 OF THIS SECTION.

BFV-1 Centerline Series A, 200 psi CWP tight shut-off.

1. Body: Lug type ductile iron. Suitable for bi-directional dead-end service at rated pressure without use of downstream flange.
2. Disc: Bronze, or aluminum bronze.
3. Stem: One or two-piece, 400 series stainless steel.
4. Seat and O-Rings: EPDM.
5. Upper and Lower Stem Bearings: Copper alloy or non-metallic material.
6. Operators: Valves 6 inches and smaller, with lever handle. Valves 8 inches and larger, with manual gear operator and disc position indicator.
7. Manufacturers:
 - a) Valves 2.5 to 6-inch: Apollo Valves LD141, Milwaukee ML 233E, Hammond 6411-03, or equal.
 - b) Valves 8-inch and larger: Apollo Valves LD141, Milwaukee ML 333E, Hammond 6411-03, NIBCO LD 2000, or equal.

C. Check Valves:

CHECK VALVES IN A DOMESTIC PLUMBING SYSTEM INTENDED TO CONVEY WATER FOR HUMAN CONSUMPTION SHALL COMPLY WITH QUALITY ASSURANCE, ARTICLE 1.03 OF THIS SECTION.

1. Bronze, 2-inch and smaller:

CHV-1: 200 psi, CWP horizontal swing, Y pattern, renewable seat and disc, threaded ends.

Manufacturer: Apollo Valves 163T-LF, NIBCO T-413-Y-LF, Milwaukee UP-509, Hammond UP-904, or equal.

APPLICATION: USE ON DOMESTIC HOT AND COLD WATER SYSTEMS.

CHV-2: 200 psi, CWP, bronze body, horizontal swing, Y pattern, renewable seat and disc, solder ends.

Manufacturer: Apollo Valves 163S-LF, NIBCO S-413-Y-LF, Hammond Up-943, or equal.

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APPLICATION: USE ON DOMESTIC HOT AND COLD WATER SYSTEMS.

2. Cast Iron 2 1/2-inch and larger:

CHV-3: Class 125, 200 psi, CWP, IBBM, renewable seat and disc, bolted cap, flanged:

Manufacturer: Apollo Valves 910F, Crane 372, Stockham G-927, NIBCO T-918-B, or equal.

D. Earthquake Valve:

EQV-1: Mechanically triggered by seismic movement, complying with state of California seismic response specifications, UL listed and certified by D.S.A. Size and pressure as required or indicated on Drawings. (Minimum 1/4 psi, maximum 10 psi. Earthquake valve shall shut off gas automatically during an earthquake to prevent an explosion or fire. Acceptable Manufacturers: California Valve (former Koso), or equal.

1. Not sensitive to vibrations caused by passing trucks or accidental bumping.
2. Sensitive to wide amplitude G's only. Preset at factory for the correct G-rating.
3. Positive sealing from minus 10 degrees F. to 150 degrees F.
4. Visual open-close indicator.
5. Manual reset.
6. Plumb line for mounting.
7. Tripping mechanism has non-creeping rolling latch.
8. Install valve per manufacturer's recommendations only.

E. Expansion Tank:

ET-1: Pressurized, vertical, steel expansion tank for potable water systems with FDA approved, replaceable, heavy duty, butyl rubber blend diaphragm, polypropylene lined dome, 1/2 inch, 3/4 inch, 1 inch or 1 1/2-inch NPT system connection, 1/2 inch or 3/4 inch drain, 0.302 inch-32 standard automobile tire valve type charging connection, lifting rings and a floor mounting skirt for vertical installation. The tank must be constructed in accordance with Section VII of the ASME Boiler and Pressure Vessel Code and stamped for 125 psi working pressure. The tank must be also rated for a continuous working temperature of 240 degrees F. Provide weather and rust resistant coating.

Manufacturer: Apollo Valves 16XT, Bell and Gossett, Wheatley, Taco, Amtrol, or equal.

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APPLICATION: FOR POTABLE WATER USE SUCH AS DOMESTIC HOT WATER SYSTEM. PROVIDE AT EACH DOMESTIC HOT WATER HEATER OR SYSTEM.

F. Flow Control Valve – Manual:

FC-1: Flow control valves: Bell and Gossett Series CB circuit setter balancing valve, line size, with integral pointer (to register degree of valve opening), differential pressure meter connections with built-in check valves and lockable memory stops. Manufacturer: Apollo Valves 58A, Armstrong ARMFLO circuit-balancing valves, series CBV, or equal.

APPLICATION: BALANCING AND CONTROLLING OF DOMESTIC HOT WATER SYSTEM FLOW FOR DIFFERENT BRANCH CIRCUITS.

G. Gate Valves:

GATE VALVES IN A DOMESTIC PLUMBING SYSTEM INTENDED TO CONVEY WATER FOR HUMAN CONSUMPTION SHALL COMPLY WITH QUALITY ASSURANCE, ARTICLE 1.03.

1. Bronze, 2-inch and smaller:

GV-1: Class 125, 200 psi, CWP, bronze body and bonnet, non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Manufacturer: Apollo Valves 101T-LF, NIBCO T-113-LF, Milwaukee UP105-P2, Hammond UP645, or equal.

APPLICATION: USE ON DOMESTIC HOT AND COLD WATER SYSTEMS.

GV-2: Same as GV-1, except solder ends:

Manufacturer: Apollo Valves 101S-LF, NIBCO S-113-LF, Milwaukee UP115, Hammond UP647, or equal.

APPLICATION: SAME AS GV-1. PROVIDE IN YARD BOX, TO EACH GROUP OF FIXTURES BEHIND ACCESS PANELS, WHERE VALVES ARE LOCATED NEAR CEILING AND BEAMS.

2. Iron, 2-1/2-inch and larger:

GV-3: Class 125 250 psi CWP iron body, flanged ends, bolted bonnet with wheel handle, resilient wedge, non-rising stem.

APPLICATION: FOR USE IN WALLS FOR DOMESTIC COLD WATER SYSTEM.

Manufacturer: Apollo Valves 610F-LFA, NIBCO F-619-RW, or equal.

GV-4: Class 125, 250 psi CWP iron body, flanged ends, bolted bonnet with 2-inch operating nut, resilient wedge, non-rising stem, fusion bonded epoxy coated.

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APPLICATION: FOR USE BELOW GRADE FOR DOMESTIC COLD WATER SYSTEM.

Manufacturer: NIBCO F-619-RW-SON, or equal.

GV-5: Class 250, 250 psi, CWP, O S and Y, IBBM, resilient seat gate valve, flanged ends.

Manufacturer: Watts 408-OSYRW, or equal.

APPLICATION: FOR FIRE PROTECTION SYSTEM.

Manufacturer: Peneberthy, Henry, Apollo Valves, or equal.

- H. Pipe and Fitting Requirements Schedule: Unless otherwise specified or indicated on Drawings, pipe and fittings shall be installed in accordance with the following table:

TABLE I
PIPE AND FITTING SCHEDULE

Use	Limits	Pipe	Fittings
Condensate drains and drains From HVAC Equipment	All sizes	P-3, or P-4 *Roof penetration & above, and exterior exposed piping shall be P-4 only	PF-3b, or PF-4 *Roof penetration & above, and exterior exposed piping shall be P-4 only
Domestic Hot and Cold water, aboveground	Interior only	P-3	PF-3a or PF-3b
Downspouts, Interior Storm Drainage	Within 5' from building, All sizes	P-1	PF-1
Waste and Vent - Indirect	All sizes	P-2	PF-2
Waste and Vent – Sanitary/ Grease	All sizes	P-1	PF-1

- I. Piping and fittings:

PIPES AND FITTINGS IN A DOMESTIC PLUMBING SYSTEM INTENDED TO CONVEY WATER FOR HUMAN CONSUMPTION SHALL COMPLY WITH QUALITY ASSURANCE ARTICLE 1.03.

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1. Piping shall be continuously and permanently marked with manufacturer's name, type of material, size, pressure rating, and the applicable ASTM, ANSI, UL, or NSF listing. On plastic pipe, date of extrusion must also be marked.
2. Underground non-ferrous pressure pipes shall be installed with proper color tracer wires. Refer to color code provisions in Section 22 0553: Plumbing Identification.

P-1: Cast iron: Hubless, service weight, ASTM A888, CISPI 301, conforming to CISPI 310 and installed in accordance to IAPMO IS 6.

Manufacturer: American Foundry, Tyler, AB & I, or equal.

PF-1: Cast iron, soil or waste, Heavy-duty no-hub coupling with neoprene gaskets, stainless steel corrugated shields and stainless steel clamps. 4 bands for size 5-inch thru 10-inch. IAPMO, ASTM C564 and CISPI 310.

Manufacturer: American Foundry, Tyler, AB & I, or equal.

P-2: Copper drainage tube, inside structure and above grade. Type DWV hard temper, ASTM B 306.

Manufacturer: Mueller, Anaconda, Cerro Brass, Cambridge-Lee, Halstead, or equal.

NOTE: USE OF COPPER TUBING TYPE DWV IS PROHIBITED FOR CONDENSATE DRAINAGE.

PF-2: Cast brass drainage fittings ASA B 16.23, ASTM B 42.

Manufacturer: Mueller Brass, Nibco, Stanley Flagg, Lee Brass, or equal.

P-3: Copper water tube, Type L hard, ASTM B88. (For above ground use only.)

Manufacturer: Mueller, Cambridge-Lee, Halstead, or equal.

NOTE: USE OF COPPER TUBING TYPE M IS PROHIBITED.

PF-3a: Copper Press-Connect pressure fittings, comply with ASME B16.51 "Copper Alloy Press-Connect Pressure Fittings", with Ethylene Propylene Diene Monomer, EPDM O-Ring Seal in each end. Fittings with the sizes of 2-1/2" and larger shall have cross-section Grab Rings and separation rings.

Manufacturer: Viega, Mueller Industries, Apollo.

PF-3b: Wrought copper - solder type ANSI B 16.22.

Manufacturer: Mueller Brass, Nibco, Lee Brass, or equal.

PROVIDE, SOLDER, AND FLUX SHALL BE LEAD-FREE. FLUX SHALL BE

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AN APPROVED WATER-SOLUBLE MATERIAL.

PF-3c: Grooved end type— ASTM B75 or B152 and ANSI B16.22 wrought copper, bronze sand casting per ASTM B584-87 copper alloy CDA 836 per ANSIB16.18. Couplings shall be CTS style 606 supplied with angle pattern bolt pads for rigidity, coated with copper coated alkyd enamel. Gaskets shall be pre-lubricated Flush seal type.

Manufacturer: Apollo Shurjoint, Victaulic, or equal.

FOR DOMESTIC HOT AND COLD WATER 2 ½-INCH AND LARGER COPPER APPLICATIONS. PROVIDE WITH PIPING SCHEDULE NUMBER P-4.

P-4: Type 316L Schedule 40 Stainless Steel chemical waste pipe, marked with manufacturer's identification and fittings. Manufacturer's representative shall instruct installers and certify them for joint installation. Piping system shall be provided with a five-year manufacturer's material warranty.

Manufacturer: Blucher-Josam, Viega, or equal.

J. Pipe Isolators:

PLA-1 Absorption pad shall be not less than ½ inch thick, unloaded. Pad shall completely encompass pipe.

APPLICATION: FOR COPPER PIPING.

Manufacturer: Holdrite, LSP, Stoneman, Potter-Roemer, Trisolator, PR-Isolator, or equal.

PLA-2 PLASTIC CUSHION TO FORM AN INSULATING LINER AND ELIMINATE METAL TO METAL CONTACT WHEN SECURING COPPER TUBES AND PIPES IN AIR CONDITIONING AND REFRIGERATION INSULATION PREVENTING GALVANIC EROSION. (ACOUSTICAL TYPE FOR SOUND ABSORPTION).

Manufacturer: Hydra-Zorb Cushion Clamps, Acousto-Clamp, or equal.

K. Pressure Gage: Aluminum or steel case, minimum 4 ¼-inch dial; pressure type or combination vacuum-pressure type, with provisions for field calibration. Dial indicator to indicate pressure in psi with accuracy to within plus or minus 0.5 percent of maximum dial reading. Furnish gages with restriction screw, size 60, to eliminate vibration impulses. Black case and ring, bourdon tube of seamless copper alloy with brass tip and socket. Three way gage cock, constructed of brass with stuffing box, 1/2 inch couplings, with fixed or movable cap nut to shut off pressure gage.

PG-1 Pressure type, black drawn steel case, 4-1/2-inch glass dial, range approximately twice line pressure.

Manufacturer: Marsh Keckley, Trerice, Weksler, Weiss, or equal.

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L. Plug Valves:

PV-1 2 inches and smaller: Rockwell No.114, lubricated plug type, 200-pound., water operating gauge pressure iron body and plug, regular pattern, threaded, with indicating arc.

Manufacturer: Walworth, Homestead, WKM, or equal.

APPLICATION: ISOLATION AND ON-OFF APPLICATION FOR GAS SYSTEM.

PV-2. 2 ½-inch and larger: Rockwell No.115 and No.165 lubricated plug type, 200 pound water operating gauge. Iron body and plug, regular pattern, flanged, with indicating arc.

Manufacturer: Walworth, Homestead, WKM, or equal.

APPLICATION: SAME AS PV-1.

M. Safety Relief Valves:

SRV-1: Combination temperature and pressure relief type. CSA approved. Set to open at 125 psi pressure.

Manufacturer: Apollo Valves: 18C, Watts: 40L, Cash-Acme: NCLX-1, or equal.

APPLICATION: HOT WATER SYSTEM.

SRV-2: Same as SRV-1, except provide on storage type water heater with anode in dip tube.

Manufacturer: Apollo Valves: 18C, Watts: 100XL, Cash-Acme: NCLX-1, or equal.

APPLICATION: SAME AS SRV-1.

N. Strainers:

STR-1 Description: Wye type with monel or stainless steel strainer cylinder (manufacturer's standard mesh), and gasketed machine strainer cap. Where indicated on Drawings, provide with valved (globe valve) blowout piping, same size as blowout plug.

1. 2-inch and smaller:

C.M. Bailey No.100-A, 250 lb., cast iron body, threaded, Keckley: Style B, Spirax Sarco Y-type, or equal.

2. 2 ½-inch and larger:

C.M. Bailey No.100-A, 125 lb., cast iron body, flanged, or Victaulic style 732, 300 psi, ductile iron body, grooved, fusion bonded epoxy coated.

Manufacturer: C.M.Bailey, Armstrong, Muessco, Keckley 'A', or equal.

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APPLICATION: OIL AND GAS SYSTEMS.

STR-2 Y pattern cast iron bodies, 125 psi, monel screen. Open area at least twice the cross-sectional area of IPS pipe in which strainer is installed and may be woven wire or perforated type. Screwed ends for sizes up to 2 inches, flanged ends fusion bonded epoxy coated for 2 ½-inch and larger perforations, in accordance with the following:

1. Other services - 16 square mesh.

Bailey No.100, Armstrong, RP&C, Keckley or equal.

APPLICATION: SAME AS STR-1.

STR-3 Flanged, bucket type, semi-steel body, 125 psi, stainless steel screen with 1/8 inch diameter perforations, all sizes.

Manufacturer: Bailey No.1, Zurn 150 Series, RP&C, Keckley GFV, or equal.

APPLICATION: DOMESTIC COLD AND HOT WATER SYSTEM. MOUNT ABOVE GRADE FOR WATER SERVICE).

- O. Vent Caps:

VC-1 Vandal-proof hood type, for plumbing vent lines.

Manufacturer: Stoneman Engineering and Mfg., Semco 1550, or equal.

APPLICATION: SANITARY DRAINAGE SYSTEM.

- P. Flanges: Flanges shall be furnished and installed at each flanged connection of each type of equipment, tanks, and valves. Faces of flanges being connected shall be furnished alike. Connection of a raised face flange to a flat-faced flange is not permitted. Flanges shall conform to following schedules:

TYPE OF PIPE	FLANGE
Screwed black or galvanized grooved steel pipelines.	125-pound black cast iron screwed flange, flat faced or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal.
Welded or grooved steel pipe, except high pressure steam lines.	150-pound black forged steel welding flanges, 1/16 inch raised face ASTM A 105, Grade II or grooved flange adapters, Apollo Shurjoint 7041, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal.

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TYPE OF PIPE	FLANGE
Copper and brass pipe or tubing.	150 pound cast bronze, flat-faced flange with solder end or grooved flange adapters, Apollo Shurjoint C341, Victaulic Style 641, Tyco-Grinnell Fig. 61, Gruvlok Fig. 6084, or equal.

1. Gasket material for flanged connections shall be full faced or ring type to suit facing on flanges and shall be furnished in accordance with following schedule:

<u>SERVICE</u>	<u>TYPE</u>
Cold water	1/16-inch-thick neoprene

Grooved end flange adapters supplied with pressure responsive elastomeric Gaskets supplied with grooved flange adapters shall be pre-lubricated by the manufacturer. Grade of gasket to suit intended service.

Q. Unions:

1. Unions shall be furnished and installed in accordance with the following requirements (unless flanges are furnished):
 - a. At each threaded or soldered connection to equipment and tanks, except in Freon or fuel gas, piping systems, whether indicated or not.
 - b. Immediately downstream of any threaded connection to each manually operated threaded valve or cock, and each threaded check valve, yard box or access box except those in Freon piping systems, whether indicated or not.
 - c. At each threaded connection to threaded automatic valves (except those in Freon piping systems) such as reducing valves and temperature control valves, whether indicated or not.
 - d. If grooved piping is used, couplings shall serve as unions. Additional unions are not required
2. Unions shall be located so that piping can be easily disconnected for removal of equipment, tank, or valve.

PART 3 – EXECUTION

3.01 EXAMINATION

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- A. Examine areas and conditions under which Work of this Section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Provide all materials and equipment for the Work. Furnish and install necessary apparatus, parts, materials, and accessories.
- B. Pipe Installation:
1. Install piping parallel to wall and provide an orderly grouping of proper materials and execution.
 2. Piping shall clear obstructions, preserve headroom, provide openings and passageways clear, whether indicated or not. Verify the Work of other Divisions to avoid interference.
 3. If obstructions or the Work of other Divisions prevent installation of piping or equipment as indicated by the Drawings, perform minor deviations as required by the ARCHITECT.
 4. Install piping after excavation or cutting has been performed. Piping shall not be permanently enclosed, furred in, or covered before required inspection and testing is performed.
 5. Exposed polished or enameled connections from fixtures or equipment shall be installed with no resulting tool marks or threads at fittings. Residue or exposed pipe compound shall be removed from exterior of pipe.
 6. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members, provide such members with reinforcement steel straps of Continental Steel & Tube Co., ULINE, Independent Metal Strap, or equal.
 7. Reduce fitting where any change in pipe size occurs. Bushings shall not be furnished unless specifically reviewed by the ARCHITECT, or indicated on Drawings.
 8. Piping subject to expansion or contraction shall be anchored in a manner, which permits strains to be evenly distributed. Swing joints or expansion loops shall be installed. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping. Seismic loops required at all building separations.

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9. Immediately after lines have been installed, openings shall be capped or plugged to prevent entrance of foreign materials. Caps shall be left in place until removal is necessary for completion of installation.
10. Couplings shall not be installed except where required pipe runs between other fittings are longer than standard length of type of pipe being installed and except where their installation is specifically reviewed by the ARCHITECT.
11. Water piping shall be installed generally level, free of traps, unnecessary offset, arranged to conform to building requirements, clear of ducts, flues, conduits, and other Work. Piping shall be arranged with valves installed to provide for complete drainage and control of system. Piping shall not be installed which causes an objectionable noise from flow of water therein under normal conditions. Refer to Section 23 0500: Common Work Results for Plumbing.
12. Water lines may be installed in same trench with sewer lines, provided bottom of water line is 12 inches minimum above top and to the side of sewer line.
13. Changes in pipe sizes shall be furnished with eccentric reducers, flat on top. Offsets to clear obstruction shall not be installed so as to produce air pockets.

C. Pipe Sleeves and Plates:

1. Provide pipe sleeves of Schedule 40 black steel pipe or Schedule 40 PVC plastic pipe in concrete or masonry walls, footings, and concrete floors below grade. Provide adjustable submerged deck type sleeves at locations where pipes pass through concrete floors, except concrete slab floors on grade, and at locations where soil pipe for floor type water closets passes through concrete floors.

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2. Sleeves shall provide ½ inch clearance around pipes, except plastic pipe shall have 1 inch clearance. Caps of deck type sleeves shall be removed just prior to installation of pipe. Area around sleeves shall be smooth and without high or low spots. Sleeves in walls shall not extend beyond exposed surface of wall. Sleeves in concrete floors and walls shall be securely fastened to forms to prevent movement while concrete is being placed.
3. Piping installed on a roof shall clear the roof surface by 10 inches minimum, with or without insulation. Bottom of individual fittings may infringe on 10 inches clear space but not groups of fittings or fittings located within 27 inches of each other.

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4. Stiles shall be provided to facilitate crossing of piping when parallel piping runs are laterally greater than 12 inches out-to-out, or any pipe is higher than 18 inches, and more than 40 feet long or runs between two or more major pieces of equipment or housings greater than 20 feet apart. Stiles shall be not less than 20 inches wide with a minimum tread depth of 10 inches. Where stiles are required, they shall be located so greatest obstructed distance is 30 feet.
5. Where pipes pass through waterproofed walls, floors, or floors on grade, sealant with Link-Seal Modular Seals, or equal, between pipe and sleeve to provide a waterproof joint. Where earth is in contact with pipe on both sides of a wall or foundation, the waterproof joint is not required. Commercial rubber compression units may be furnished instead of sealed sleeves if reviewed by the ARCHITECT.
6. A swing joint, or other required device, shall be furnished and installed in hot water lines with 10 feet of sealant or compression joint to allow for expansion.
7. Provide polished, chrome-plated flanges when plumbing pipes pass through walls at plumbing fixtures, etcetera as specified in Section 22 1000 Plumbing. Provide polished steel, chromium-plated split floor and ceiling plates at locations where pipes pass through walls, floors, ceilings, and partitions in finished portion that neatly conceals pipe insert.
8. Pipe sleeves shall be provided where pipes intersect footings or foundation walls and sleeve clearances shall provide for footing settlement, but not less than one inch all around pipe.

D. Welding of Pipe and Qualifications of Welder:

1. Joints above grade or accessible conduit or tunnels in steel piping may be either welded or screwed unless specifically indicated otherwise on Drawings or specified. Joints in below grade steel piping, whether in insulation or not, shall not be welded, unless otherwise indicated.
2. Welded joints in pipe shall be continuous around pipe and shall comply with ASME B31: Code for Pressure Piping, unless otherwise specified.
3. Each pipe weld shall be stamped with welder's identification mark. Welding shall be performed by welders possessing a valid certificate of qualification for welding carbon steel welding pipe in horizontal position (2G) and horizontal fixed position (5G) in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code, by an OWNER-recognized, DSA approved testing laboratory.
4. Before any welder performs welding on the Work, furnish the INSPECTOR with a copy of welder's valid qualification papers and obtain verification.

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Welder qualification is not valid unless it has been issued while welder was performing work for current employer, and has performed type of work described by qualification in the preceding 3 months.

REFERENCE: ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-29 TESTS OF WELDERS AND WELDING OPERATORS.

5. Welding performed under these Specifications is subject to special tests and inspections including rigid Ultra Sonic Testing (UT) and radiographic inspection at random, in accordance with Technique for Radiographic Examination of Welded Joints by an OWNER recognized, DSA approved testing laboratory.

ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-51 RADIOGRAPHIC EXAMINATION OF WELDED JOINTS.

E. Unacceptable Welds and Repairs to Welding:

1. Welds containing any of the following types of imperfections shall be deemed defective Work:
 - a. Cracks of any type.
 - b. Zones of incomplete (in excess of 1/32 inch) fusion or penetration.
 - c. Elongated slab inclusions longer than 1/4 inch.
 - d. Groups of slag inclusions in welds having an aggregate length greater than thickness of parent metal in a length 12 times the thickness of the parent metal.
 - e. Undercuts greater than 1/32 inch.
 - f. Overlaps, abrupt ridges or valleys.
3. When a defective weld is detected by examination as outlined above, two additional welds shall be radiographed at locations selected by the Project Inspector. If the two selected welds demonstrate compliant welding, then the two tested welds shall be deemed to be in compliance. Welding revealed by radiographs to be defective Work shall be removed, repaired, and tested by radiograph.
4. If either of the two selected welds demonstrates welding deemed to be defective Work, all welding in that portion of the Work shall be deemed defective Work and either: all welds shall be cutout, prepare new ends for welding and weld to comply with this Specification, or radiograph all welds, removing and repairing only such welding deemed to be defective Work.

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5. Repair welding shall be performed in a manner in full compliance with ASME B31. The welded joints or repairs shall be spot examined with UT or radiographic tests in accordance with foregoing requirements.

REFERENCE, ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-52.

6. OWNER shall cause to be performed additional random UT and radiographic examinations of welds. OWNER shall be responsible for the costs of any UT and radiographic examinations found to be in compliance with specified requirements.
 7. Installer shall be responsible for the costs of UT and radiographic re-examinations of welds deemed defective Work and not in compliance with this Specification, and shall repair or replace said welds in accordance with specified requirements.
- F. Welding Rods: Submit a written list of materials and proposed type of welding rods.
- G. Backing Rings: Backing rings may be submitted for installation provided the Product Data is submitted with the material list.
- H. Qualification Tests for Low-pressure Welding:
1. Tests shall be performed on 3-inch standard weight pipe ASTM A53, Grade A, and shall be welded by acetylene and electric arc. Each sample shall consist of 2 pieces, each 10 inches long, with 30-degree bevel at point weld.
 2. Two 20-inch samples shall be performed in the 2G and two 20-inch samples in the 5G positions, with positions defined in Section IX, ASME Boiler and Pressure Vessel Code. Welds shall have the reinforcement ground or machined flush to the surface of the pipe before testing. Samples shall be tested as full section tensile.
 3. Weld shall develop a load of 90 percent of 50,000 psi, i.e., 45,000 psi or shall develop a fracture in parent metal.
 4. Each qualified welder shall carry an identification card listing welder's name, date of test, and type of welding tests passed; signed by the welder and the laboratory.
 5. A valid certificate of qualification issued in compliance with requirements of the ASME Boiler Pressure Vessel Code Section IX shall qualify a welder for issuance of a certificate for low-pressure pipe welding.
- I. Certificates of Qualification for Welding of Unfired Pressure Vessels:

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1. Certificates of qualification shall be issued by a laboratory recognized by the OWNER in compliance with the requirements of the ASME Boiler Pressure Vessel Code Section IX. Qualifications shall be for both acetylene and arc welding of Schedule 40 ASTM A53, Type B, steel welded or seamless pipe in the Horizontal Position (2G) and the Horizontal Fixed Position (5G) as defined by said code.
 2. Certificate described above is not valid unless it has been issued while welder was working for his current employer, and unless welder has performed type of work described by certificate in the preceding three months. Requirements for possession of a valid certificate shall not be waived for welders fabricating unfired pressure vessels when the Specifications require compliance with ASME code or when welding pipe carries working pressures greater than 75 psi and temperatures greater than 250 degrees F.
- J. Pipe Joints and Connections:
1. Pipe and tubing shall be cut per IAPMO Installation Standards. Pipe shall have rough edges or burrs removed so that a smooth and unobstructed flow shall be provided.
 2. Hot tapping of gas lines is strictly prohibited.
 3. Threaded Pipe: Joints in piping shall be installed according to the following service schedule:
 - a. Plastic Piping: Teflon pipe joint compound tape.
 - b. Cleanout Plugs: No compound shall be used. After inspection and test, plugs shall be removed, cleaned, greased, and replaced.
 - c. Other services furnish sealant, suitable and as reviewed by the ARCHITECT.
 4. Threads on pipe shall be cut with sharp, clean, unblemished dies and shall conform to ANSI/ASME B2.1 for tapered pipe threads.
 5. Joint compounds shall be smoothly placed on male thread and not in fittings. Threaded joints shall be installed tight with tongs or wrenches and sealant of any kind is not permitted. Failed joints shall be replaced with new materials. Installation of thread cement or sealant to repair a leaking joint is not permitted.
 6. Sharp-toothed Stillson, or similar wrenches, is not permitted for the installation of brass pipe or other piping with similar finished surfaces.
- K. Copper Tubing and Brass Pipe with Threadless Fittings:

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1. Silver brazed joints shall be used for attaching fittings to non-ferrous metallic refrigerant piping.
2. Non-pressure gravity fed condensate lines may be soldered with 95/5 solder.
3. Silver brazing alloy, Class BCUP-5. Surfaces to be joined shall be free of oil, grease, and oxides. Socket of fitting and end of pipe shall be thoroughly cleaned with emery cloth and wiped to remove oxides. After cleaning and before assembly or heating, flux shall be installed to each joint surface and spread evenly. Heat shall be applied in accordance with instructions in the Copper Tube Handbook issued by Copper Development Associates. Joints constructed of rough bronze fittings shall be provided as recommended by manufacturer.
4. Do not overheat piping and fittings when installing silver brazing.
5. Joints in non-ferrous piping for services not covered above shall be installed with solder composed of 95/5 tin/antimony, ASTM B32, Grade 5A. Surfaces to be jointed shall be free of oil, grease, and oxides. Sockets of fitting and end of pipe shall be cleaned with emery cloth to remove oxides. Solder flux shall be sparingly installed and solder added until joint is completely filled. Do not overheat. Excess solder, while plastic, shall be removed with a small brush in order to provide an uninterrupted fillet completely around joint. Random inspection of joints shall be conducted by Project Inspector to ensure joints are lead-free.
6. Grooved end joints for copper piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
7. Pressed fittings for copper or copper alloy pipe or tubing shall have an elastomeric O-ring that forms the joint. The pipe or tubing shall be fully inserted into the fitting, and the pipe or tubing marked at the shoulder of the fitting. Pipe or tubing shall be cut square, mechanically cleaned and reamed prior to joining to remove all burrs (interior and exterior) and restore full inside diameter and a smooth, chamfered exterior surface. The fitting alignment shall be checked against the mark on the pipe or tubing to ensure the pipe or tubing is inserted into the fitting. The joint shall be pressed using the tool recommended by the manufacturer.
 - a. Press Installation Training Requirement: Installation training shall be provided on site by manufacturer personnel and documented with Engineer. Installation procedures, depth guides, and tool inspection shall be provided by manufacturer for all product types (steel or copper) for reference and safety assurance.

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- L. Ring-Type Pipe: Joints shall be installed in accordance with manufacturer's instructions with grooved couplings, fittings and rubber rings. Couplings and pipe shall be compatible and of the same manufacturer. Rings shall be accurately located and installed by grooves in coupling. Pipe shall be installed with zero deflection unless otherwise specified. Pressure pipe shall be furnished with thrust blocks at each offset point.
- M. Welded Pipe Joints:
1. Joints in welded steel pipelines shall be installed by oxyacetylene or electric arc process. Welding shall be continuous around pipe and provided as specified.
 2. Butt welds shall be of the single V-type, with ends of pipe and fittings beveled approximately 37 ½ degrees. Piping shall be aligned before welding is started with the alignment maintained during welding.
 3. Welds for flanges and socket fittings shall be of the fillet type with a throat dimension not less than pipe wall thickness.
- N. Grooved End Pipe Joints: Grooved end joints for carbon steel piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to grove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
- O. Stainless steel press joints: Joints shall be Vic-Press 304TM, or equal, made with Victaulic Series 'PFT' tools and the appropriate sized jaw. Pipe shall be certified for use with Vic-Press 304TM system, and shall be square cut, properly deburred and cleaned, and marked at the required location to insure full insertion into the fittings and/or couplings.
- P. Polyethylene (Plastic) Pipe:
1. Joints shall be installed by the heat fusion method, in accordance with manufacturer's recommendations and IAPMO installation standard IS 12, for natural gas.
 2. Pipe Riser at Meter, Regulator and Building Wall: Prefabricated, anodeless type, utilizing a grade level transition between underground polyethylene pipe and gas supply steel pipe of riser outlet, GF Piping Systems, or equal. Below grade to above grade transition shall be installed in a welded, epoxy coated, steel casing.
- Q. Valves: Valves shall conform to the following:

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1. Piping systems shall be furnished with valves at points indicated on Drawings and specified, arranged to provide complete regulating control of piping system throughout building and the Project site.
2. Valves shall be installed in a neat grouping, so that parts are easily accessible and maintained.
3. Valves shall be full size of line in which they are installed, unless otherwise indicated on Drawings or otherwise specified, and shall be one of types specified.
4. Provide chain operators on valves 2-inch and larger located 7 feet or more above the servicing floor level.
5. Valves for similar service shall be of one manufacturer.
6. Except where otherwise specified, valves shall be Apollo, Belimo, Victaulic, Stockham, Crane, Jenkins, Milwaukee, Hammond, American, NIBCO, Hoffman, or equal.
7. Ball valves below grade in yard boxes shall have stainless steel handles.
8. Hose bibs in dense garden areas shall be $\frac{3}{4}$ inch in size with one hose bib in the lunch pavilion 1 inch in size. Other hose bibs shall be $\frac{3}{4}$ inch lock shield type. Bibs shall be furnished with vacuum breaker protection.
9. Safety valves and pressure relief valves shall have stamp of approval as required by ASME and shall be provided with annual test lever. Where a hot water storage tank is heated by means of a coil, pressure relief valve shall have a steam BTU discharge rating of the coil. Discharge pipe from safety or pressure relief valves shall be not less than one pipe size larger than inlet pipe size of valve. Discharge pipe shall terminate as indicated and shall be free of traps. In addition to locations specified, pressure relief valves shall be installed in the following locations:
 - a. On discharge side of each pressure-reducing valve.
 - b. On each water heater connected to a hot water storage tank and other pressure vessels.
 - c. On cold water line to each water heater or hot water storage tank when there is a check valve, backflow prevention valve or similar device between water heater or hot water storage tank and meter or relief valve at the pressure reducing valve assembly.
 - d. On discharge side of each air compressor.

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- e. On each air receiver connected to an air compressor.
- 10. Temperature relief valves and combination temperature and pressure relief valves shall be as specified and furnished as set forth in this Section. Discharge pipe from relief valves shall be not less than discharge area of valve or valves it connects, based on discharge area of valves, and shall terminate as indicated and free of any traps. Valves shall be installed at following locations:
 - 11. A combination temperature and pressure relief valve or combination of valves on each heating hot water storage tank. Temperature sending element shall extend into water inside tank.
 - 12. Manual air vent valve assemblies shall be installed at each high point of hot water space heating and chilled water piping systems. Valves shall discharge through 1/4 inch diameter copper tubing and drain to nearest floor sink. Automatic type air vent valve shall only be installed where specifically indicated. Radiator, convectors, and finned pipe convectors shall be fitted with packless radiator valves, angle or straight pattern. Each convector or radiator installed as part of a space hot water heating system shall be furnished with a manual-type air vent valve.
- R. Strainers: Strainers shall be installed on each water main (except for fire line) downstream of the meter, above grade, when a pressure regulator assembly is not installed. Main strainer shall be of Y-flange or groove type. On closed loop chilled and heating hot water systems pump systems, a strainer shall be installed at each pump inlet and upstream of each flow control valve assembly. The control valve assembly may include a modulating temperature control valve and a flow-limiting valve, manufactured by Griswold, AutoFlow, Flow Control Industries, Inc., or equal.
- S. Hangers and Supports:
 - 1. Piping shall be securely fastened to building structure by approved iron hangers, supports, guides, anchors, and sway braces to maintain pipe alignment to prevent sagging and to prevent noise or excessive strain on piping due to uncontrolled or seismic movement under operating conditions. Hangers and supports shall conform to Manufacturer's Standardization Society Specification SP-69. Hangers shall be relocated as required to correct unsatisfactory conditions that may become evident when system is placed into operation. Appliances, heat exchangers, storage tanks, and similar equipment shall be securely fastened to structure in accordance with seismic requirements. Outdoor metal hangers and supports shall be hot-dipped galvanized steel, unless otherwise specified.
 - 2. Hose faucets, compressed air outlets, and similar items at ends of pipe branches shall be rigidly fastened to building construction near point of connection.

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3. Piping shall not be supported by wire, rope, wood, plumbers' tape, or other non-recognized devices.
4. Hangers and supports shall be designed to support weight of pipe, fittings, weight of fluid and weight of pipe insulation, and shall have a minimum factor of safety of five, based on ultimate tensile strength of material installed.
5. Burning or welding of any structural member under load is not permitted. Field welding not specified on Drawings or reviewed Shop Drawings is not permitted without review by ARCHITECT and DSA.
6. Burning holes in beam flanges or other structural members is not permitted without review by the ARCHITECT and DSA.
7. Pipe hangers on piping covered with low temperature insulation shall be installed on outside of insulation and not in contact with pipe unless otherwise detailed on Drawings. Insulation shall be protected by 18 gage galvanized steel shield, with a minimum length of 10 inches, installed completely around pipe covering between covering and hanger. Installing hangers directly on pipe and butting adjoining sections of insulation against hanger is permitted provided void and hanger rod are properly insulated and sealed so that no sweating occurs at hangers.
8. Hanger rods shall be fastened to structural steel members with suitable beam clamps. Clamps shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco I beam, Fig.62 for maximum 1000 pounds.
 - b. Tolco I or WF beam, Fig. 329, for maximum of 1290 pounds.
9. Hanger rods shall be fastened to concrete inserts in concrete slabs or beams. Inserts shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco Fig.310 for maximum of 600 pounds.
 - b. Tolco Fig. 309 for maximum of 1140 pounds.
10. For fastening to wood ceilings, beams, or joists, furnish Grinnell Fig. 128R, Grinnell Fig. 153, Tolco 78, or equal pipe hanger flange fastened with drive screws. Under wood floors, 3/8 inch hanger rods shall be hung from 2-inch by 2-inch by 1/4 inch angle clips 3 inches long, with 2, staggered 10d nails, clinched over joist.

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11. Pipe hanger rod sizes: 3/8-inch for pipe sizes 1/2-inch through 4-inch, 1/2-inch for pipe sizes 5-inch through 8-inch, and 5/8-inch for pipe size 10-inch through 12-inch.
12. Where rod hangers are used with a diameter greater than 3/8-inch, they shall be equipped with swivels or eye nuts to prevent bending in the rod.
13. Turnbuckles, if furnished, shall provide a load carrying capacity equal to that of the pipe hanger with which they are being installed.
14. Pipe hangers shall be of same size, or nearest larger manufactured size available, as pipe or tubing on which they are being installed.
15. Hangers, clamps, and guides furnished for support of non-metallic pipe shall be padded with 1/8 inch thick rubber, neoprene, or soft resilient cloth.
16. Where special pipe-supporting requirements in the Specifications conflict with any standard requirements specified herein, the Specification requirements shall govern.
17. Vertical Piping:
 - a. Vertical pipe risers shall be securely supported with riser clamps of recognized type. Risers in reinforced concrete buildings shall be furnished with extension clamps fastened to pipe above each concrete floor slab with extended arms of clamp to rest on slab. Clamps shall be provided with lead or Teflon liners when installed on copper tubing. Clamps shall be plastic-coated when installed on non-ferrous pipe or tubing.
 - b. Copper tubing in sizes 1 1/2-inches and larger and steel pipelines passing up through building shall be supported at each floor of building or every 15 feet whichever is less.
 - c. Copper tubing sizes 1 1/4-inches and smaller shall be supported at not intervals not more than 6 feet on center. Special provisions shall be installed for vertical lines subject to expansion and contraction caused by operating temperature differences.
 - d. Vertical cast iron pipelines shall be supported from each floor and at its base. Malleable iron or steel pipe clamps with minimum thickness of 1/4 inch shall be furnished and fastened around pipe for support.
18. Horizontal Piping:
 - a. Roof Mounted Piping: Pressure and non-pressure piping shall be supported from channels, stands, clamps, trapezes, rollers, or

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structures mounted on 100% rubber, UV resistant rooftop supports with reflective strips, Dura-Block, or equal. Roller type supports shall be provided below and above pipe to prevent its dislodgement. Bottom of pipes shall clear the roof surface by 10 inches.

- b. Insulated steam and space heating hot water insulated condensate lines, insulated domestic hot water supply and return piping shall be supported with Tolco Figure 4, B-Line Figure B3140, Grinnell Figure 212, or equal, steel hangers with welded eye rods to permit hinge movement at point of attachment of hangers. Hinge movement at point of support shall be provided by welded eye linked rods Tolco Figure 101L, B-Line Figure B3211X, Grinnell Figure 278, or equal.
 - c. Domestic cold water piping, water supply and return piping, condenser water piping, cast iron soil piping, galvanized steel vents, waste and downspout piping and glass to be supported with Tolco Figure 1, B-Line Figure B3100, Grinnell Figure 260, or equal, hangers with rods, turnbuckles and inserts suitable for above hangers.
 - d. Maximum hanger and support spacing shall conform to CPC schedule for horizontal piping installed above grade.
19. A hanger or support shall be installed close to the point of change in direction of a pipe run, in either a horizontal or vertical plane.
 20. When practicable, supports and hangers for cast iron soil pipe shall be installed as close as possible to joints and when hangers or supports are not located within one foot of a branch line fitting, an additional hanger or support shall be installed at fitting.
 21. In systems where grooved piping is used, couplings shall be provided with angle pattern bolt pads to comply with support and hanging requirements of ANSI/ASME B31.1, ANSI/ASME B31.9, and NFPA Pamphlet 13.
- T. Flashings:
1. Each pipe, duct, or gas-fired equipment vent passing through roof shall be installed with waterproof flashing.
 2. Flashing or flanges on pipes, vents, and ducts passing through a tile or slate roof shall be constructed of sheet lead. Flashing for pipes and heater vents passing through a roof shall be 4 pound soft sheet lead. Flashing and flanges for ducts and heater vents passing through exterior walls shall be 22 gage sheet metal. Install caps on top of heater pipes. Flanges and flashing shall be installed waterproof at point of connection with pipe or duct by welding. No soldered joints on roof flashings will be allowed. No Stoneman lead roof flashings will be allowed.

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3. Lead flashing and flanges shall be constructed of 4 pound sheet lead with burned joints. Flange of lead flashing or lead flange on a duct shall extend out onto roof a minimum of 12 inches from pipe or duct. Lead flashing shall extend up the pipe or duct not less than 8 inches.
 4. Sheet metal flashing shall be constructed of 24 gage galvanized sheet steel. Flanges on these flashings shall extend out onto roof a minimum of 10 inches from pipe or duct. Flanges on ducts through exterior walls shall extend out from duct a minimum of 2 ½ inches. Flanges on gas-fired equipment single-wall vents shall be of ventilated type. Type B gas vents through a roof shall be furnished with non-ventilated flashing as per NFPA Pamphlet 211.
 5. Cast iron, steel, brass, and copper pipe, which terminates less than 18 inches above roof, shall be furnished with a combination counter-flashing and vandal-proof hood for protection against water, birds and foreign matter. Cast iron, steel, brass and copper pipe, which does not terminate within 18 inches of roof, shall be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with protection against entrance of water, birds, and foreign matter.
 6. Counter-flashing and combination counter-flashing sleeves and vandal-proof hoods shall be cast iron, vandal-proof, threaded, sealed or approved gas-heated sleeve type. Counter-flashing sleeves on each of these items shall extend down over flashing a minimum of ¾ inch.
 7. Storm collars shall be securely screwed and installed waterproof around appliance vent pipe immediately above flashing.
 8. Vent piping above roof shall be furnished with a combination counter-flashing sleeve and vandal-proof hood.
- U. Equipment Installation: Install roof or floor mounted equipment on level platforms, housekeeping pads or curbs and provide sound, vibration and seismic control measures per Section 23 05 48 even if not indicated on Drawings.

END OF SECTION

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SECTION 22 05 53 - PLUMBING IDENTIFICATION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Marking and identification on mechanical piping systems, ducts, controls, valves, and apparatus.
- B. Related Requirements:
 - 1. Division 01: General Requirements
 - 2. Section 21 13 13: Fire-Suppression Sprinkler Systems.
 - 3. Section 22 05 13: Basic Plumbing Materials and Methods.
 - 4. Section 22 10 00: Plumbing.

1.02 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 22 05 00: Common Work Results for Plumbing.
- B. Submit product data and installation instructions for each item specified.
- C. Submit Samples of materials.

1.03 QUALITY ASSURANCE

- A. Comply with provisions of:
 - 1. Section 22 05 00: Common Work Results for Plumbing.
 - 2. ANSI/ASME A13.1: Scheme for the Identification of Piping Systems.
 - 3. APWA: Uniform Color Code.
 - 4. IAPMO: Uniform Plumbing Code (UPC)

PART 2 – PRODUCTS

2.01 MATERIALS

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- A. General: Piping systems, controls, valves, apparatus, etc., except those that are installed in inaccessible locations in partitions, walls, and floors, shall be permanently identified.

2.02 VALVES

- A. Furnish prepared chart or diagram for each piping system, indicating by identifying letter or model number of each valve in the system, its location, and function.
- B. Install charts in aluminum frame with clear glass front and secure on wall where designated by the Project Inspector.
- C. Bind copies of each chart in operating instructions manual.
- D. Provide each valve with a brass, aluminum, or plastic disc, not less than 1-1/4 inches diameter bearing engraved numbers corresponding to those indicated on chart. Fasten discs to valve with No. 14 brass wire.
- E. Provide an additional tag for safety valves and other valves that could be hazardous to safety and health of occupants. Distinguish these tags from regular valve tags by color (such as yellow with black letters and marked "Danger"); submit Sample tag to the Architect for review.

2.03 INSTRUMENTS AND CONTROLS

- A. Identify panel-mounted instruments and controls with engraved bakelite nameplates permanently affixed to panel boards.
- B. Identify alarm indicating devices and alarm reset devices by nameplates.
- C. Identify automatic valves, flow switches, and pressure switches, with embossed aluminum or plastic tape affixed to controller, indicating service and setting.

2.04 EQUIPMENT

- A. Identify each major piece of equipment with engraved bakelite nameplates permanently affixed to the equipment, indicating the room numbers it services, Equipment identification designation shall be the same to its designation indicated on the "As-Built Drawings". Room numbers in the nameplates shall correspond to the final room numbers.

2.05 ABOVE GRADE PIPE IDENTIFICATION

- A. Identify pipes by means of colored labels with directional flow arrows and identification of the pipe content, in conformance to ANSI/ASME A13.1 or the UPC.
- B. Materials: Precoiled acrylic plastic with clear polyester coating, all-temperature, self-adhering, as manufactured by Brady, Brimar Industries, Seton, Stranco, Inc., or equal.

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C. Size:

Outside Diameter of Pipe or Insulation (in inches)	Length of Color Field (in inches)	Size of Letter (in inches)
$\frac{3}{4}$ to $1\frac{1}{4}$	8	$\frac{1}{2}$
$1\frac{1}{2}$ to 2	8	$\frac{3}{4}$
$2\frac{1}{2}$ to 6	12	$1\frac{1}{4}$
8 to 10	24	$2\frac{1}{2}$
over 10	32	$3\frac{1}{2}$

D. Locations:

1. On accessible piping, whether insulated or not (including mechanical rooms, attic and ceiling spaces); except that labels shall be omitted from piping where contained material is obvious due to its connection to fixtures (such as faucets, water closets, etcetera.).
2. Near each valve and branch connection in such accessible piping.
3. At each pipe passage through wall or floor.
4. At not more than 20 feet spacing on straight pipe run between bands required in 2 and 3 above.
5. At each change in direction.

E. Application: Install on clean surfaces free of dust, grease, oil, or any material that will prevent proper adhesion. Replace non-adhering or curling labels with new labels.

F. Color Schedule:

Content of Pipe	Legend	Background Color	Lettering Color
Domestic cold water	Domestic. C.W.	Green	White
Non-potable cold water	Caution: Non-potable Water Do Not Drink (1)(2)	Purple	Black
Domestic hot-water	Domestic H.W.	Blue	Black
Sanitary waste	San waste	Green	White
Sanitary vent	San vent	Green	White

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Storm drain or downspout	Storm drain	Green	White
Indirect drain	Ind drain	Green	White
Fire sprinkler supply	Fire Sprinkler supply	Red	White
Fire sprinkler drain	Sprinkler drain	Red	White
Reclaimed Water	Caution: Reclaimed Water Do Not Drink (1)(3)	Purple	Black

H. Notes on Schedule:

1. Note (1) indicates 2 ¼ inch by 1 inch yellow label with ½ inch letters reading UNSAFE WATER at one end of primary label.

Note (2) words should read "CAUTION: NONPOTABLE WATER DO NOT DRINK." with international *do not drink* symbol.

Note (3) words should read "CAUTION: RECLAIMED WATER DO NOT DRINK." with international *do not drink* symbol.

2.06 UNDERGROUND PIPE

A. Detectable Marking Tape:

1. Provide and install detectable marking tape along buried piping. Tape shall be specifically manufactured for marking and locating underground utilities with electronic equipment. Tape shall be acid and alkali resistant, and manufactured with integral wires or foil backing, encased with protective cladding. Tape shall be a minimum of two inches in width.
2. Manufacturer: Reef Industries, Inc., Advantage Brands, Inc., Northtown Company, Mutual Industries, Inc., or equal.
3. Detectable marking tape shall be color-coded per APWA Color Code:
 - a. Yellow: Oil and gas.
 - b. Blue: Water, irrigation and slurry lines.
 - c. Green: Sewer and drain lines.

B. Tracer Wire:

1. Solid copper wire type THWN, 12 AWG gauge, with heat and moisture resistant insulation.

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PART 3 – EXECUTION

3.01 INSTALLATION

- A. Correct detrimental conditions prior to commencing the Work of this Section. Install markers and identification tags as specified with materials and installation procedures recommended by manufacturer.
- B. Place tracer wire on top of non-metal utility lines allowing some slack. Do not wrap tracer wire around pipe. Fasten tracer wire in place at approximately 10 feet on centers with non-metal ties.
- C. Install underground detectable pipe marking tape continuously buried 8 to 10 inches above the buried utility pipe. Wrap tape on pipe risers up to a height of 12 inches above grade.

3.02 CLEANUP

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

END OF SECTION

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SECTION 22 10 00 - PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Labor, materials, tools, and equipment to install plumbing systems as indicated.
- B. Related Sections:
 - 1. Division 01 - General Requirements.
 - 2. Section 07 92 00: Joint Sealants.
 - 3. Section 10 44 13: Fire Extinguishers and Cabinets.
 - 4. Section 22 05 00: Common Work Results for Plumbing.
 - 5. Section 22 05 13: Basic Plumbing Materials and Methods.
 - 6. Section 22 05 53: Identification for Plumbing piping and Equipment.
 - 7. Section 22 07 00: Plumbing Insulation.
 - 8. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 22 05 00: Common Work Results for Plumbing.
- B. Provide necessary documentation to Owner for processing rebates for water efficient fixtures.

1.03 QUALITY ASSURANCE

- A. Unless otherwise noted, the California Plumbing Code is hereby made part of this section.
- B. Conform to provisions of Section 22 05 00: Common Work Results for Plumbing.
- C. Manufacturer of plumbing products must be third-party certified to ANSI/NSF Standard 61, Section 9 certification, and ANSI/NSF 372 to demonstrate

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compliance with the federal requirements for lead contribution to drinking water, the Safe Drinking Water Act SDWA, and the California Health and Safety Code Section 116875.

1.04 PRODUCT HANDLING

- A. Conform to provisions of Section 22 05 13: Basic Plumbing Materials and Methods.

PART 2 - PRODUCTS

2.01 PIPING SYSTEMS

- A. Materials: Refer to Section 22 05 13: Basic Plumbing Materials and Methods.
- B. Insulation for Piping: Refer to Section 23 07 00: Plumbing Insulation.

2.02 FIXTURES AND DRAINS

- A. General: Fixtures specified shall be furnished complete with trim and fittings. Cast iron plumbing fixtures shall be acid resistant enamel, and identified by casting letters "AR" or words "acid-resistant" into metal. Fixtures shall be white unless otherwise specified. Cast iron fixtures shall be white enamel inside and on back, rim and apron, with exposed unfinished surfaces painted white. Fixtures of same general classifications shall be of same make.
- B. Finished Brass:
 - 1. Unless otherwise specified, finished brass of a similar type shall be of same manufacturer and model throughout buildings.
 - 2. Finished and exposed brass plumbing, except floor, shower and urinal drains shall be chromium-plated and polished. Floor, shower and urinal drains, unless otherwise specified, shall be nickel-bronze metal.
- C. Traps, Trap Arms and Tailpieces:
 - 1. Fixture Traps shall be all L.A. Code Cast Brass Chromium-plated and polished. Exceptions as follows:
 - a. Traps that are an integral part of a fixture.
 - b. Traps concealed in floors, walls and furring.
 - c. Traps standard for service sinks and Industrial Shop equipment.

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- d. Tailpieces shall be as specified in section 22 05 13 "Basic Plumbing Materials and Methods".
 2. Trap Arms shall be all IPS Threaded Brass Nipples into Female IPS Threaded Drainage Tee.
 3. Tailpieces, Extension Tailpieces, 2-part wastes and any other tubular products shall be minimum 17 gage polished chromium-plated brass, except as otherwise specified.
 4. Furnish polished chromium-plated brass wall flanges with setscrews and polished chromium-plated brass cover casing on discharge side of each trap.
- D. Faucet Handles: Faucet handles shall be solid brass, chromium-plated and polished, and fastened to their stems by Allen type hollow head stainless steel set screws through the side of the handle extending into the stem. Handles with sharp edges or projections shall not be furnished. At accessible fixtures: handles shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate handles shall be 5 pounds maximum.
- E. Fixture Supplies:
1. Supplies for water heaters shall be unplated rigid copper water tube with threaded adaptors for connections to valves and other threaded connections. All other supplies shall be chromium-plated brass with hospital threads or shall be furnished with fittings and valves, which completely cover threads.
 2. Exposed supplies for showers shall be chromium-plated brass pipe up to header with hospital threads or shall be furnished with fittings and valves, which completely cover threads.
 3. Supplies to water closet tanks, lavatories, and drinking fountains shall be furnished with an NSF 372/61 threaded brass nipple. Exposed unfinished piping shall be sleeved with chrome plated brass or copper cover casing and have an appropriate escutcheon for a clean finished appearance. Angle/straight valve stops shall be female 1/2 IPS (inlet) by 3/8 compression (outlet). Fixture supplies shall be polished chrome-plated, solid supply bulbed end risers with size compatible supply nut connection to fixture and 3/8 O.D. compression nut and ferrule connection to angle stop outlet. Stainless steel flexible braided connectors with re-enforced PVC inner hose are not allowed.
 4. Hot and cold water fitting supply outlet piping serving water closets, urinals, lavatories, drinking fountains, sinks, faucets, hose bibs, and sillcocks shall be iron pipe size (IPS) brass nipple, and piped in such a manner that through wall water supply outlet piping be removable, size appropriate, and

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lead free. The use of copper, copper MIP sweat adapters or similar fittings, in lieu of brass nipples is not allowed. The IPS brass nipple shall be directly connected to the fixture as follows:

- a. Control stops for water closet and urinal flush valves.
 - b. Angle stop for lavatories, sinks and drinking fountains.
 - c. Shank/arm adapters for wall mounted sink faucets.
 - d. Iron pipe size (IPS) brass nipple connection for hose bibs, sillcocks, and other plumbing related fixture and/or plumbing fitting water supply outlets.
5. Water supply pipe that penetrates a finished surface, wall, countertop or part of a cabinet shall be appropriately sized polished chromium-plated cover casing and wall flange/escutcheon fitting tight to the brass through wall nipple and securely affixed to the finished wall surface.
 6. Water supplies of plumbing fixtures shall be protected against back-siphonage in event of a vacuum in piping system. Toilet and urinal flush valves shall be furnished with recognized atmospheric vacuum breakers, installed a minimum of 6 inches above fixture.
 7. Discharge outlets of supply faucets for lavatories and sinks shall clear top of overflow rim by at least one inch.

2.03 ACCESS PLATES (To cleanouts, valves, water hammer arrestors and hose faucets)

A. Schedule Numbers:

AP-1: Square, unless otherwise noted, steel, prime coated; frame, 18 gage minimum. Door shall be 16 gage minimum with concealed hinge or be removable, with vandal-proof lock operated by Allen wrench. (Specify for painted and stucco walls.)

SMITH	ZURN	ELMDOR	MILKOR	WATTS	MIFAB	JOSAM
Fig 4760 AK	Z-1462- VP	DW-AKL	MOR DW AK1	CO-300- S-6	UA-A	58650-VP

AP-2: Round type, stainless steel, vandal-proof, 5/16 inch No. 18 or 1/4 inch No. 20 flat-head machine screw into cleanout plug. Plate shall be prime coated minimum 18 gage steel or polished chrome-plated brass, 18-8 No. 302 stainless steel, or polished nickel bronze.
(To be specified for painted walls, screwed into cleanout plug.)

SMITH	ZURN	JOSAM	WADE	WATTS	MIFAB
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4710U	Z-1469-VP	58600	8480R	CO-480-RD-6	C1400-RD-6
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AP-3: Square, polished face chrome-plated bronze, aluminum alloy or brass chrome-plated brass frame with 14 gage polished 18-8 No. 302 stainless steel or brass chrome-plated secured cover with vandal-proof screws. (To be specified for tile walls.)

SMITH	ZURN	WADE	WATTS	MIFAB	JOSAM
4735U	Z-1460-VP	58630	CO-300-S-6	C1400-S-3-6	58640-VP

2.04 CLEANOUT ASSEMBLIES

A. Cleanout plug shall be line size.

B. Schedule Numbers:

CO-1: Iron body cleanout tee full line size up to 4 inches and round access plate, plugs shall be brass, countersunk with tapped boss for 5/16 inch No. 18 or ¼ inch No. 20 screws. (Specify for finished walls at base of waste stack, above urinal and service sink.) AB&I and TYLER may be used as iron body cleanouts. Trim and accessories shall be Smith or Zurn or equal.

SMITH	ZURN	WATTS	MIFAB	JOSAM
4532-U	Z-1446-BP	CO-460-RD-34B	C1460-RD-6	58600-CO

CO-2: Iron body with approved UPC plug, top and adjustable sleeve, cut-off ferrule, polished scoriated brass nickel bronze secured cover. AB&I and TYLER may be used as iron body cleanouts. Trim and accessories shall be Smith or Zurn or equal (To be specified for finished floors inside buildings, in covered areas, and in concrete paving.)

Square:

SMITH	ZURN	WATTS	MIFAB	JOSAM
4053L-U-NB	ZN-1400-T	CO-200-S	C1220-S-1-6	55000-1-SQ

Round:

SMITH	ZURN	WATTS	MIFAB	JOSAM
4033-L-U-NB	ZN-1400	CO-200-R	C1220-1-6	55000-1

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CO-3: Secured cover, extra heavy-duty, adjustable sleeve, cut-off ferule, UPC. Brass approved type plug, scoriated tractor type cover.

(To be specified for areas outside building on concrete paving.)

SMITH	ZURN	WATTS	MIFAB	JOSAM
4233-U	ZN-1400-HD	CO-200-RX-4	C1220-4-6	55000-22

CO-4: Tapped soil tee with brass plug, full line size.

(Specify for above grade, outside building at base of exposed downspout.)

SMITH	ZURN	WATTS	MIFAB	JOSAM
4512	Z-1445-BP	CO-460-34A	C1460	58910

CO-5: Raised threaded head brass plug.

(To be specified for yard box YB-3.)

ZURN	WATTS	SMITH	JOSAM
Z-1470-A	CO-590	4285	58540-20

2.05 CIRCULATING PUMPS, HOT WATER HEATING SYSTEM

A. Schedule Numbers:

CPH-1: Centrifugal, single stage, close coupled with adjustable cast iron base, bronze enclosed impeller, lead-free mechanical shaft seal suitable for water temperature range from 20 degrees to 300 degrees F. Screwed or flanged connections. GPM and TDH capacities as indicated.

BELL & GOSSETT	WEIMAN	PACIFIC	TACO
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CPH-2: In-line mounted. Close coupled, centrifugal type with an all bronze water chamber, bronze sleeve bearings, bronze impellers, water tight shaft seal suitable for water temperature range from 20-300 degrees F. Forged steel shaft. It must be provided with bracket support to damper vibrations. GPM and TDH capacities as indicated.

BELL & GOSSETT All Bronze	GRUNDFOS	TACO
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2.06 DRINKING FOUNTAINS

DF-1: Accessible surface mount filtered stainless steel bottle filling station with filter.

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ELKAY	ELKAY	ELKAY	OR EQUAL
EZWSMDK with filter EWF3000	LZWSDK with filter EWF3000	LZWSMDK with filter EWF3000	

2.07 DIELECTRIC UNION

A. Schedule Numbers:

1. Dielectric style Unions using ferrous and no-ferrous metals are prohibited. Dielectric flanges are admitted for use – see DU-2.

DU-1: Lead Free Brass union with 6-inch Lead Free Brass nipple.

DU-2: Lead Free Brass union or Lead Free Brass flanged fittings are to be used in between pipes made of dissimilar metals to prevent accelerated corrosion and deterioration in the piping systems due to galvanic and stray current.

WATTS	WILKINS	ZURN	NIBCO
LF3100M3			733-LF

2.08 FAUCETS

A. Not Used.

2.09 FLOOR DRAINS

A. Not Used.

2.10 FLEXIBLE HOSES

A. Schedule Numbers:

FLH-1: Braided bronze metal hose (for non-pressure condensate connection use). US Flex, Metraflex, Nelson Dunn or equal.

2.11 FLUSH VALVE ASSEMBLY

A. Not Used.

2.12 FLOOR SINKS

A. Not Used

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2.13 HOSE BIBBS

A. Schedule Numbers:

HB-1: For plaster or stucco wall, furnished with box and stop, exposed trim chrome-plated, with or without door and with vacuum breaker.

(To be specified for use in swimming pool area, outside eating area and at 75 feet spacing around exterior building walls.)

ACORN
8141, 8151

HB-2: For brick, CMU and poured in place concrete walls, furnished with box and stop, exposed trim chrome-plated, with or without door and with vacuum breaker.

(To be specified for use in swimming pool area, outside eating and 75 feet spacing around exterior building wall.)

ACORN
8141, 8104, 8151

HB-3: ASTM B 62 bronze body, rubber composition disc or renewable seat, straight nose with brass die cast or enamel iron hand wheel and with vacuum breaker.

(To be specified for use for Lath House.)

ACORN
8131-RBVB

HB-45: Same as HB-3 except furnish with bent nose.
(To be specified for use at roof top AC Unit. Mechanical Equipment Room, Boiler Rooms, etc.)

ACORN
8126-LK-RBVB

HB-7: Renewable seat, rough chrome finish, bronze body, flanged 3/4 inch I.P.S. with Female thread inlet, loose key, and vacuum breaker.

ACORN
8121-CR

HB-8: Recessed hose box furnished with wall flange and built-in drip lip. Box shall be one piece construction; door shall have a recessed cam lock. Door shall remain up and

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out of the way when in fully opened position. Valve shall be replaceable loose key wheel handle and screwdriver stop. Install within 2 feet above finished floor. Provide vacuum breaker.

(To be specified for use in Toilet Rooms.)

ACORN
Hose box 8104 or 8151

2.14 LAVATORIES

A. Not used

2.21 PIPE HANGERS

A. Refer to Section 22 05 13: Basic Plumbing Materials and Methods.

B. Schedule Numbers:

1. PH-1: Complete with clamps, inserts, etc.

SUPERSTRUT	UNISTRUT	TOLCO	B-LINE
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2.22 P-TRAPS

A. Schedule Numbers:

PT-1: Cast brass complete, chrome-plated.

AB&A
107

2.23 PRESSURE REGULATING VALVE ASSEMBLIES

A. Not Used.

2.24 ROOF DRAINS

A. Not Used.

2.25 SERVICE SINKS and TRIM

A. Not Used.

2.26 STOP VALVES

Budlong

3361-008-000

PLUMBING
22 10 00-9

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A. Stops shall be loose key type, 1/2-inches IPS inlet and outlet chrome-plated brass casting, except as noted.

B. Schedule Numbers:

STV-1: Angle:

CHICAGO,	BRASSCRAFT	NIBCO
442-LKABCP		77

STV-2: Partition:

CHICAGO	T & S BRASS
1771-ABCP	B-1028

STV-3: Straight Type, with Loose Key:

CHICAGO	BRASSCRAFT	T&S BRASS
45-LKABCP (1/2 inch)		B-O418

2.27 TRAP PRIMERS

A. Not Used.

2.28 URINALS

A. Not Used.

2.29 WATER CLOSETS

A. Not Used.

2.30 WATER HEATERS / DOMESTIC BOILERS

A. Not Used.

2.31 WATER HAMMER ARRESTORS

WHA-1: Lead Free Water Hammer Arrestor provided for Headers for Lavatories, Wash Sinks, Service Sinks, Urinals and Water Closets. For sizing purposes size according to manufacturer's recommendations.

SIOUX CHIEF	PPP	JR SMITH	WATTS	JOSAM
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655 and 656 SERIES	SC SERIES	5005 TO 5050 SERIES	Series LF05 and LF15M2	75000
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2.32 YARD BOXES

A. Schedule Numbers:

YB-1 Yard Boxes: 14 3/4-inch by 20-inch by 12-inch, cast concrete, with cast iron hinged locking traffic cover marked "GAS"

(For use over gas stops for portable buildings only, on addition to accessible emergency shutoff valve on building.)

BROOKS No. 36-HFL Assembly with cast iron hinged locking cover

YB-2: Same as YB-1, marked "WATER" (For use over water valves).

BROOKS No. 36-HFL Assembly with cast iron hinged locking cover

YB-3: Same as YB-1, marked "SEWER"

BROOKS No. 36-HFL Assembly with cast iron hinged locking cover

2.33 HEIGHT OF FIXTURES

A. Not Used.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which Work of this section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General:

1. Unless otherwise specified, plumbing fixtures, equipment and appliances that require connections to plumbing line shall be connected. This shall

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include fixtures specified or indicated as furnished by others, furnished by Owner, or specified in other related sections. Install supplies, stops, valves, traps, wall flanges, or pipe casing for connection of this equipment.

2. Install equipment as indicated on reviewed and accepted Shop Drawings.
 3. Avoid interference with Work of other trades. Do not deviate from Drawings without review of the Architect.
- B. Examination: Check each piece of equipment in system for defects verifying that parts are properly furnished and installed.
- C. For piping Work, refer to Section 22 05 13: Basic Plumbing Materials and Methods.
- D. Plumbing Fixture and Equipment Installation:
1. Unless otherwise indicated, fixtures shall be installed with 5/16 inch brass bolts or screws of sufficient length to securely fasten fixture to backing, wall, or closet ring.
 2. Fixtures installed against concrete or masonry walls shall have their hangers fastened with 5/16 inch brass bolts, Philip Shield type anchors, or 2 unit cinch anchors. Wood or plastic plugs are not permitted.
 3. Fixtures installed against wood or metal stud walls shall have their hangers fastened to metal backing plates with 5/16 inch brass bolts screwed into plate. Fixture hangers for urinals shall be fastened centered vertically on metal backing plate with three 5/16 brass bolts each for small individual hangers and six, for larger one piece hangers. Lavatories shall be hung with not less than four 5/16 inch brass bolts or not less than five 1/4 inch brass bolts. Each sink hanger shall be hung with not less than four 5/16 inch brass bolt or not less than five 1/4 inch brass bolts.
 4. Pan type drinking fountains shall be hung with 5/16 inch cadmium plated bolts with a bolt in each bolt opening in hanger. Hangers for pan type drinking fountains shall provide 2 inches (plus or minus 1/4 inch) between pan and wall. Spaces due to irregularities between fixtures and tile walls shall be neatly filled with white cement or silicone filler.
 5. Backing for hanging of plumbing fixtures and equipment shall be installed in supporting wall at time rough piping is installed. Backing for stud walls shall be steel plate 1/4 inch thick, not less than 4 inches wide. Backing for urinals shall be 1/4-inches thick by 6-inch wide steel plate. Steel plate shall be attached to stud at each end of plate and to each stud it crosses. Plate shall be attached to metal studs by bolting with two 1/4 inch U-bolts per stud with bolts through plate and around stud flange or by welding with a 1/8 inch fillet weld full width of stud flange, top and bottom of plate. At wood

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studs, plate shall be carefully recessed flush with face of stud and attached to each stud with 2 No. 14 flat-head wood screws, 2 inches in length into pre-drilled 1/8 inch holes. Backing for stud walls supporting wall-hung closets shall be as detailed.

6. Rough-in for fixtures, equipment and appliances shall be as indicated on Drawings and as specified, including those items indicated as furnished by others, furnished by Owner, or future capacity. When connections to equipment from capped or plugged lines are required, caps or plugs shall be removed at time equipment is set and stops or valves installed and connections provided as specified.
7. Piping shall be stubbed out to exact location of fixtures and stubs shall be installed symmetrical with fixtures. Hot and cold water supplies for center set faucets on lavatories shall be installed on 8-inch centers, unless otherwise specified or required.

E. Cleanouts in Drain, Waste, Vent and Sewer Lines:

1. Cleanouts shall be installed at locations stated in the California Plumbing Code and accessible at following locations:
 - a. At locations above first floor as stated on construction documents and 5 feet outside of the building.
 - b. Install an accessible main line upper terminal cleanout in all restrooms above water closet overflow. (Install above upper terminal water closet where there are more than one water closets in a restroom).
 - c. Above faucets of each sink with brass plug.
 - d. Above service sink with brass plug.
 - e. At each Drinking Fountain with brass plug.
 - f. At each urinal and locate above urinal with brass plug.
 - g. Above overflow level of pot sinks with brass plug.
 - h. In vertical line at base of each downspout connected to an underground storm drain system extend cleanout to exterior of building.
 - i. At upper end of a horizontal vent line when any part of horizontal line is below overflow level of fixture it serves.

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- j. Not to exceed 100-foot intervals in sewer and waste lines exterior of building.
 - k. At property line connection.
 - l. Where indicated on Drawings.
2. Cleanouts shall be extended to grade as follows:
- a. Not to exceed 100-foot intervals in straight runs of pipe outside buildings.
 - b. At horizontal changes of direction in aggregate greater than 135 degrees (underground).
 - c. At property lines.
 - d. Where cleanouts occur under concrete.
 - e. Where marked for future connections.
3. Cleanouts in building shall be extended to floor level or above floor level or above floor level in walls or furring when cleanouts are not accessible or where clearance is less than 18 inches.
4. Cleanouts in finished areas in building shall be concealed except that cleanouts above service sinks in janitor's rooms or closet, and cleanouts above service sinks or in exposed piping in boiler or heater equipment rooms, may be exposed. Cleanouts for urinals shall be installed above urinal and shall terminate behind an access plate.
5. Cleanouts in floors of covered areas and those extended to grade in concrete areas shall be floor level type with extensions body brass plugs and detachable nickel-bronze or aluminum alloy scoriated.
6. Concealed cleanouts in vertical lines shall be service weight soil cleanout tees with brass plugs and round cover plates unless otherwise specified or indicated. A snug fitting sleeve of galvanized sheet metal shall be placed around hub of tee and shall extend to flush with finished soil, or cleanout shall be extended to finished wall.
7. Cleanouts extended from below floor to a wall or furring or on horizontal lines above floor that terminate at a wall or furring shall be iron body type with brass plugs and round cover plates.
8. Cover plates over cleanouts in painted walls shall be steel, bonderized and prime coated. Cover plates cover cleanouts in tile walls shall be chromium-

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plated brass or nickel bronze. Plates shall be attached to cleanout plugs with 5/16 inch No. 18 or 1/4 inch No. 20 stainless steel vandal-proof type screws. Plates shall be one inch larger in diameter than fitting opening.

9. Cleanouts at bases of downspouts shall be tapped soil tees with brass plugs as hereinafter specified, full size of line.
10. Cleanouts extended to grade in exterior sewer lines other than floors or concrete areas shall be a cleanout assembly with secured top, extra heavy-duty, adjustable sleeve, cut-off ferrule, countersunk threaded brass plug and scoriated tractor type cover.
11. Other cleanouts shall be iron body type.
12. Cleanout extensions shall be no-hub cast iron soil pipe. Exterior cleanouts, those in concrete excepted, shall terminate in a 14-inch by 6-inch thick concrete block with cleanout assembly and top of block flush with finish grade.
13. Fittings in lines utilized as cleanouts shall be approved soil fittings including no-hub pipe. Tees and crosses in vent headers excepted.
14. Pipe joint compound shall not be installed on cleanout plug. After lines are tested and approved, each cleanout plug shall be removed, greased, and replaced.

3.03 EXCAVATION, TRENCHING AND BACKFILLING

- A. Perform trenching, excavation, and backfilling required for Work of this section as specified herein and in Section 31 23 23: Excavating, Backfilling, and Compacting for Utilities.

3.04 SERVICE CONNECTIONS

- A. Determine exact location of required water, drain, and sewer connections and provide proper connections.
- B. Potable water lines shall be purged completely before connecting to sources of water for the Project. Determine quality of water supply before connection.

3.05 WATER HAMMER ARRESTORS

- A. Install water hammer arrestors indicated on Drawings and in following locations (only non-ferrous arrestors may be installed in copper water system):

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1. Water lines to lavatory headers, water closet and urinal headers, service sinks, sinks, wash fountains, drinking fountains, laboratories with medical type faucets and on wash sinks having three or more stations and all other quick closing fixture such as clothes washers, as close to fixture as possible.
 2. Between last two fixtures when three or more fixtures, other than those listed in Number 1 above, are served by a common header.
- B. When possible, arrestor shall be installed in wall or furring. When arrestor is installed in wall or furring, furnish an access plate large enough to permit removal of arrestor. Access plate shall be a minimum of 2 inches larger in each direction than the arrestor.
- C. Fixture water lines shall be provided with mechanical water arrestor hammer dampening devices. Air chambers are not approved.

3.06 CONDENSATE DRAINS - FROM AIR CONDITIONING UNITS

- A. Connect drain piping from drain pan of air conditioning unit to condensate disposal location indicated. When coil or unit housing is shock or vibration isolated, connection shall be furnished through a flexible connector not less than 10 inches long. Drain line shall pitch to flow out at not less than one inch in 8 feet. Drain line shall not be reduced smaller than unit outlet connection.
- B. Condensate drain piping installed within building whether in air-conditioned space or not shall be insulated. Refer to Section 22 07 00: Plumbing Insulation, for type of material required.
- C. Condensate Trap:
1. A condensate trap shall be installed for each air conditioning coil. Trap shall be assembled from 2 brass unions: one between A/C unit and inlet of trap, and one at outlet of trap that connects to main drain.
 2. Trap configuration shall be per manufacturer's recommendations based on total unit casting static pressure (simulated plugged filter condition), but not less than 3 inch water seal.
 3. Running trap design is not permitted.
 4. Secondary drain shall not be trapped.
- D. Condensate trap shall be checked at equipment operational tests for proper water drainage flow from air conditioning unit. Cooling condensate pan shall be filled with water, filters covered with plastic (plugged filter simulated), unit panels replaced, and unit motor running at design condition. Pan shall drain without

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hesitation to bottom of inlet connection. Tests are made prior to installation of ceiling.

E. Secondary Overflow Drain:

1. Drain pans installed underneath air conditioning units in concealed ceiling space or units that incorporate dam fitting shall be furnished with secondary drain piped to outside planter area with outflow location clearly visible.
2. If outside building location is not available or feasible, secondary drains shall be piped to a classroom sink, if sink is not available pipe to a room corner away from cabinets, computers, desks, door ways/entrances or stairs.
3. Secondary vertical pipe that penetrates through suspended ceiling shall be furnished with a coupling or threaded adapter so ceiling tile can be removed without damage.

3.07 CONDENSATE DRAINS - FROM WINDOW TYPE HEAT PUMP AND EXTERIOR WALL MOUNT HEAT PUMP UNITS

- A. Whether indicated on Drawings or not, window units and wall mount units without built in bottom drain pan for evaporator and condenser coils shall be provided with galvanized steel condensate pan at bottom of unit with drain line that drains into approved drywell. Install copper 1/2 inch diameter pipe for window type air conditioners and 3/4 inch diameter pipe for exterior wall-mounted heat pump units.

3.08 MAKE-UP WATER SYSTEMS

- A. Provide and connect make-up water systems for equipment in other sections.

3.09 DISINFECTING DOMESTIC WATER PIPING SYSTEMS

- A. Newly installed or replaced piping and/or fixtures dispensing potable water, and any additional piping and/or equipment impacting the integrity of this system shall be disinfected and undergo an approved bacteriological analysis before water system is allowed for public use.
- B. Disinfection shall commence upon complete installation of all related domestic water systems including fixtures, valves, faucets, water heating systems, etc.
- C. Work shall be performed by Technicians Certified by the American Water Works Association (AWWA) and/or the State of California Department Health Services, Grade II Water Treatment Operator Certification or higher issued by the Department of Health Services (DHS) for the State of California. Comply with Title

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22, Code of Regulations Division 4, Chapter 13, and Article 2 Operator Certification Grades.

D. Method:

1. A Physical Separation of minimum 6" or Reduced Pressure Backflow assembly shall be installed to protect from cross contamination of the local water purveyor's meter service supply when at any time there is any type of water connection with the piping to be disinfected (Chlorinated) and the water meter service supply.
2. Install a Chlorination Port including a T fitting and a shut off valve to the proximity of the point of connection at the new piping system.
3. System is to be flushed to remove any materials that may have entered the system.
4. Using a chemical feed metering pump and a chlorine tank, the chlorine solution is injected into the water system.

E. Disinfection and De-chlorination procedure (24 or 3 Hour Contact Time):

1. 24-hour Test Method:

- a. Prior to disinfection, post signs on all water outlets of the system to be disinfected. Sign or tags shall read, "Water System Being Chlorinated- "Danger Do Not Drink Water" or similar warning.
- b. Piping system shall then be adequately flushed with water to remove any particles and eliminate air pockets.
- c. Using the continuous feed method, sodium hypochlorite conforming to ANSI/ AWWA B300 will be injected into the water system at a minimum of 50 PPM. A water flow meter provided by the water treatment technician will be used to determine the rate of injection and a chlorine test kit, Hach or equivalent, will be used to monitor the residual.
- d. Chlorine residual test will be taken at all appropriate points and outlets to verify 50 PPM residual levels.
- e. The chlorinated system shall be shut down for any use and the chlorinated water shall remain in the water system for retention of 24 hours.
- f. After 24 hours, chlorine residual levels will again be tested at various points throughout the system to insure a minimum of 25

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PPM residual. If the system has not met the minimum of a 25 PPM residual, the above disinfection process shall be repeated.

- g. After satisfactory completion of the residual testing, flush out system until Hach or equivalent test reveal the water outlets have a free chlorine residual concentration less than 0.5 PPM. The procedure shall be in accordance with the AWWA standard C651-05.
 - h. The OAR may allow temporary use of the water system for construction purposes pending results of the bacteriological test analysis. Sign or Tags shall be left on all outlets stating water system is not safe for consumption until laboratory results are complete and meet these specifications.
2. 3 Hour Test Method:
- a. If the water systems must be turned on for use as soon as possible, a 3 hours chlorine contact time to allow for disinfection is permitted with the OAR's approval.
 - b. Prior to disinfection, post signs on all water outlets of the system to be disinfected. Sign or tags shall read, "Water System Being Chlorinated- "Danger Do Not Drink Water" or similar warning.
 - c. Piping system shall be then adequately flushed with water to remove any particles and eliminate air pockets. Using the continuous feed method, sodium hypochlorite conforming to ANSI/ AWWA B300 will be injected into the water system at a minimum of 200 PPM. A water flow meter provided by the water treatment technician will be used to determine the rate of injection and a chlorine test kit, Hach or equivalent, will be used to monitor the residual.
 - d. Chlorine residual test will be taken at all appropriate points and outlets to verify 200 PPM levels. The chlorinated system shall be shut down for any use and the chlorinated water shall remain in the water system for retention of 3 hours.
 - e. After satisfactory completion of a 3 hour disinfection period, flush out system until Hach or equivalent test reveal the water outlets have a free chlorine residual concentration less than 0.5 PPM. The procedure shall be in accordance with the AWWA standard C651-05.
 - f. The OAR may allow temporary use of the water system for construction purposes pending results of the bacteriological test analysis. Sign or Tags shall be left on all outlets stating water

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system is not safe for consumption until laboratory results are complete and meet these specifications.

F. Bacteriological Test:

1. After final flushing and satisfactory results from the residual free chlorine concentration test, Bacteriological test samples shall be collected. The intent of the following is to provide insurance for an accurate representation to a complete Bacteriological test of the water system. At least two samples shall be taken from each floor of each building.
2. Bacteriological test samples shall be delivered to a State of California Department of Health Services Certified Laboratory to perform qualitative and quantitative bacterial analyses on the water samples for the presence of any Total Coliform bacteria and Plate Count. This count must be less than 500 cfu/mL.
3. The procedure shall be repeated if it shown by bacteriological examination made by an approved agency that the level of Disinfection does not meet these specifications.
4. After satisfactory results for the bacteriological test are provided to the OAR, the physical barrier or temporary reduce pressure back flow devise shall be removed, and the new piping shall be connected to the point of connection. All the connecting piping and fittings shall be disinfected prior to installation. Chlorination Port shall be capped water tight. Warning sign or tags shall be removed.

G. Drinking Fountain and Bottle Filler Lead Test: After installation of Drinking Fountain or Bottle Filler, and successful Bacteriological Test, shut off domestic water supply line feeding the fixture, and inform OAR. OAR will coordinate with the Drinking Water Quality Program (DWQP) Supervisor in local Project Unit and M&O's Plumbing Technical Unit Supervisor to conduct lead detection test and mitigate as necessary. Do not remove related construction warning sign and tags.

3.10 VALVES ON PLUMBING SYSTEM

- A. Furnish and install gates, ball, globes, angles, and check valves on plumbing Work at following locations whether indicated on drawings or not.
- B. Hot and cold valves shall be:
 1. Lead free complying with AB1953.
 2. Above the ground copper water system, 2-inch and larger, may utilize Victaulic butterfly valves and fittings for their connections. A 2-inch or larger

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Victaulic valve may be in a wall if an adequately sized access panel is provided for maintenance or removal.

- C. Valves shall be accessible and installed within an access panel approximately 3 feet above floor and no more than 7 feet above floor, or in a marked yard box to prevent tampering.
1. Immediately after each water meter, in addition to any valve furnished by utility company, there shall be an accessible valve on the inlet side for a strainer assembly, dual backflow device assembly and/or possibly a dual pressure reducing valve assembly.
 2. A gate or ball valve on each water supply before it enters building. Valves shall be accessible from outside building and shall be installed in a marked yard box, unless otherwise indicated on drawings. Ball valves 2 ½-inch size or larger shall omit gate valve handle and furnish 2-inch square operating nut.
 3. At multi story buildings, provide an isolation-valve or multiple valves for both hot and cold water in access panel to isolate and control each floor level.
 4. For classrooms, shops, offices and boiler or mechanical room, install a gate or ball valve to control hot and cold water lines to each group of fixtures, a group of fixtures shall be considered to be 2 or more fixtures in the same room. When practical, valves shall be installed on the same wall as group of fixtures. Valves shall control only fixtures in rooms in which they are installed.
 5. For restrooms, a gate or ball valve shall be installed in each restroom to isolate the hot and cold water supply into a restroom regardless of the number of fixtures. These valves shall control and be accessible only from within the restroom in which fixtures are installed. Valves shall be installed on the same wall as the group of fixtures it serves. Valves shall control only fixtures in restroom in which they are installed. Back to back restrooms shall be isolated separately and individually.
 6. Install a gate or ball valve on each building branch line, which serves two or more fixtures, when these fixtures are not provided with a group isolation valve as specified above. These valves shall be located approximately 3 feet but not more than 7 feet above finish floor.
 7. Install a gate, ball valve or partition stop for a drinking fountain or a group of drinking fountains.

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8. Install a gate, ball valve or partition stop for hot and cold water supply to plumbing fixtures with no accessible supply stops, such as wall mounted faucets.
9. Install a gate, ball valve or partition stop for stops adjacent to, and controlling water flow to each sill cock and hose bib except as follows:
 - a. A sill cock immediately below an exterior drinking fountain may be controlled by the same gate, ball valve or partition stop as drinking fountain.
 - b. Valves or stops will not be required for individual hose bibs when these hose bibs are on a branch line serving only hose bibs and branch line is furnished with a shut-off valve.
10. Install a loose key angle stop, on each exposed fixture supply, and for each flush valve unless otherwise specified,
11. Install gate or ball valve at each location where a water line is connected to a piece of equipment other than items mentioned above.
12. Install a check valve on each hot water return line where it connects to a hot water storage tank or a water heater.
13. Handles, hand wheels (including dishwasher fill valve handles) and operating nuts shall be furnished of steel, brass, or cast iron and shall be removable. Unless specified to be loose key type, handles shall be securely fastened to their stems. On exposed outdoor valves, omit operating handles and provide operating nuts.
14. Provide a handle or a key for each five, or fraction thereof, loose key valves, bibs, or stops and deliver them to the project OAR.

3.11 ELECTROLYSIS PREVENTION

- A. Brass nipples, 6 inches, with recognized brass unions; flanges shall be furnished and installed at locations described herein. Flanges shall be installed with complete insulating component consisting of gasket bolt sleeves and bolt washers. Dielectric insulators shall be installed at following locations:
 1. Where special applications indicated on Drawings require an insulation flange or brass union, with 6-inch brass nipple to be installed in a condensate line, or steam line, flange insulation shall be of a high temperature type, suitable for continuous operation at temperatures up to 220 degrees F. for condensate and 400 degrees F. for steam.

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2. Where steel or cast iron in ground connects to copper or brass piping above ground, transition from steel or cast iron pipe to copper or brass pipe shall be provided in an accessible location.
3. Underground dielectric connections shall be furnished in accessible yard boxes.
4. Above ground dielectric connections shall be exposed; or if in finished rooms shall be located in accessible access boxes.

3.12 UNDERGROUND PIPE MARKERS

- A. Pipe markers shall be furnished according to Section 22 05 53: "Plumbing Identification"
- B. Underground Caution Tape shall be placed 12 to 18 inches above the utility line. The Caution Tape shall be a designated color and marked with the appropriate name for the specific type of utility pipe as follows:
 1. Yellow – with the words: CAUTION GAS LINE BELOW
 2. Blue – with the words: CAUTION WATER LINE BELOW

3.13 HOT WATER CIRCULATING PUMPS

- A. Floor-mounted pumps shall be provided with a 4-inch high concrete base with ½ inch reinforcing bars at 12-inch centers each way and doweled into concrete floor.
- B. Piping shall be supported from building structure so as to prevent any strain on pump casing.
- C. In-line pumps, unless otherwise specified, shall be centrifugal type with non-overloading characteristics and shall not overload motor above its horsepower rating under operating conditions with ratings based on continuous operation.
- D. Centrifugal water pumps shall be rated according to Hydraulic Institute Test Code for Centrifugal Pumps. Pumps shall be furnished with bronze water chamber, bronze impeller and mechanical seal. Rotating parts shall be statically and dynamically balanced.
- E. Flanged connections shall be provided on pumps with discharge connections larger than 2 inches. Smaller sizes may be threaded connections.
- F. Hot water circulating pump shall be arranged so that pump can be automatically turned off when hot water system is not in operation.

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3.14 WATER TEMPERATURE CONTROLLERS

- A. Furnish and install a water temperature controller in hot water line adjacent to, and for control of, circulating pumps on hot water return lines when said pump is indicated on Drawings or herein specified. Bulb of temperature controller shall be installed so as to be directly in path of flowing water and so as not to obstruct flow of water.
- B. Furnish and install a water temperature controller in hot water storage tanks for control of circulating pump on hot water circulating line when said pump is indicated on Drawings or specified herein.

3.15 DEPTH OF SEWER LINES

- A. Minimum depth of below grade sewer lines shall be 24 inches to centerline of pipe. Sewer lines shall slope $\frac{1}{4}$ inch per foot minimum, unless otherwise indicated. Minimum depth at Owner property line shall be 6 feet, unless otherwise required.

3.16 BACKFLOW PREVENTION DEVICES

- A. Backflow Devices: Installation of backflow devices shall be tested and certified by Ventura County backflow device tester before Substantial Completion. Tests shall be performed in presence of Project Inspector. Test reports shall be turned over to Project Inspector for mailing to proper agency.

3.17 CLEANUP

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

3.18 PROTECTION

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

END OF SECTION

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SECTION 23 01 30 - HVAC AIR DUCT CLEANING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. This Section includes cleaning of the following existing air duct systems:

- a. Supply system.
- b. Return system.
- c. Exhaust and Transfer system.

B. Related Requirements:

- a. Division 01 - General Requirements.
- b. Section 23 30 00 - Air Distribution.
- c. Section 23 07 00 - HVAC Insulation
- d. NADCA Standard ACR.
- e. NADCA General Specification for the Cleaning & Restoration of Commercial HVAC System.
- f. UL181 Standard for Factory-Made Air Ducts and Air Connectors.

1.02 DEFINITIONS

- A. ACR: Assessment, Cleaning, and Restoration of HVAC Systems.
- B. ASCS: Air systems cleaning specialist.
- C. HEPA: High Efficiency Particulate Arrestance.
- D. HVAC: Heating, Ventilation and Air Conditioning.
- E. NADCA: National Air Duct Cleaners Association.
- F. OEHS: Office of Environmental Health & Safety.

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- G. SDS: Safety Data Sheet.
- H. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.
- I. UL: Underwriters Laboratories.

1.03 SUBMITTALS

- A. Qualification Data for ASCS as indicated on NADCA General Specification.
- B. Strategies and Procedures Plan before starting the work.
- C. Cleanliness Verification Report at the project completion.

1.04 QUALITY ASSURANCE

- A. ASCS Qualifications:
 - 1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
 - 2. Supervisor Qualifications: Certified as an ASCS by NADCA.
- B. UL Compliance: Comply with UL 181 "Standard for Factory-Made Air Ducts and Air Connectors" requirement.
- C. Cleaning Conference: Conduct conference at Project site. Review methods and procedures related to HVAC air-distribution system cleaning including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine HVAC air-distribution equipment systems to determine appropriate methods, tools, and equipment required for performance of the Work.
- B. Perform "Project Assessment and Recommendation" according to current NADCA ACR Standard.
- C. Prepare written report listing conditions detrimental to performance of the Work.
- D. Proceed with work only after unsatisfactory conditions have been corrected, and OAR's approval has been obtained.

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3.02 PREPARATION

- A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:
 - 1. Supervisor contact information.
 - 2. Work schedule including location, times, and impact on occupied areas.
 - 3. Methods and materials planned for each HVAC component type.
 - 4. Required support from other trades.
 - 5. Equipment and material storage requirements.
 - 6. Exhaust equipment setup locations.
- B. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection. Refer to Construction Documents for quantities.
- C. Comply with current NADCA ACR Standard, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.03 CLEANING

- A. Comply with current NADCA ACR Standard Requirement.
- B. Do not use any chemicals in the process of cleaning unless there is a significant reason. Using any kind of chemicals is subject to the OAR's approval. Prior to the application of any chemical, ASCS is required to submit SDS document of proposed cleaning materials to OAR in order to obtain product approval from OEHS. Do not apply any material unsafe for hard metal surfaces.
- C. Systems and Components to be Cleaned by a qualified ASCS:
 - 1. Air devices for supply and return air.
 - 2. Ductwork:
 - a. Supply-air ducts, including turning vanes and reheat coils, to the air-handling unit.
 - b. Return-air ducts to the air-handling unit.
 - c. Exhaust-air and Transfer-air ducts.

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- D. Perform cleaning before air balancing or mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
- E. Use duct-mounted access doors, as required, for physical and mechanical entry and for inspection.
 - 1. Install additional duct-mounting access doors to comply with duct cleaning standards. Comply with requirements in Section 23 30 00 "Air Distribution" for additional duct-mounting access doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection. Replace damaged and deteriorated flexible ducts. Comply with requirements in Section 23 30 00 "Air Distribution" for flexible ducts.
 - 3. Disconnect and reconnect flexible connectors as needed for cleaning and inspection. Replace damaged and deteriorated flexible connectors. Comply with requirements in Section 23 30 00 "Air Distribution" for flexible connectors.
 - 4. Replace damaged fusible links on fire and smoke dampers. Replacement fusible links shall be same rating as those being replaced. Comply with requirements in Section 23 30 00 "Air Distribution" for fusible links.
 - 5. Remove and reinstall ceiling components to gain access for duct cleaning. Clean ceiling components after they have been removed and replaced.
- F. Particulate Collection and Odor Control:
 - 1. Where venting vacuuming system inside building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size or greater particles.
 - 2. When venting vacuuming system outside building, use filtration to contain debris removed from the HVAC system and locate exhaust down wind and away from air intakes and other points of entry into building.
- G. Clean the following metal-duct system components by removing visible surface contaminants and deposits:
 - 1. Air outlets and inlets: registers, grilles, and diffusers.
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling-unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.

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4. Coils and related components.
 5. Return-air ducts, dampers, and actuators, except in ceiling plenums and mechanical room.
 6. Supply-air ducts, dampers, actuators, and turning vanes.
 7. Dedicated exhaust and ventilation components.
- H. Mechanical Cleaning Methodology:
1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 - a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
 - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.
 2. Cleaning Mineral-Fiber Insulation Components:
 - a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to current NADCA ACR Standard. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 - b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests, refer to current NADCA ACR Standard.
 - c. Fibrous materials that become wet shall be discarded and replaced in-kind.
 3. Clean coils and coil drain pans according to current NADCA ACR Standard. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

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4. Provide operative drainage system for wash-down procedures.
 5. Biocidal Agents and Coatings: Apply Biocidal agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply Biocidal agents and coatings according to manufacturer's written recommendations and OEHS registration listing after the removal of surface deposits and debris.
 - a. When used, Biocidal treatments and coatings shall be applied after the system is rendered clean.
 - b. Apply Biocidal agents and coatings directly onto surfaces of interior ductwork.
 - c. Sanitizing agent products shall be registered by the OEHS as specifically intended for use in HVAC systems and ductwork.
 6. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- I. Cleanliness Verification:
1. Verify cleanliness according to current NADCA ACR Standard, "Verification of HVAC System Cleanliness" Section.
 2. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
 3. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and re-inspected.
 4. Additional Verification:
 - a. Perform surface comparison testing or NADCA vacuum test.
 - b. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.
 5. Prepare a written cleanliness verification report. At a minimum, include the following:
 - a. Written documentation of the success of the cleaning.
 - b. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.

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- c. Surface comparison test results if required.
- d. Gravimetric analysis (nonporous surfaces only).
- e. System areas found to be damaged.

3.04 CONNECTIONS

- A. Reconnect ducts to fans and air-handling units with existing flexible connectors after cleaning ducts and flexible connectors. Replace existing damaged and deteriorated flexible connectors.
- B. For fans developing static pressures of 5-inch w.g. and higher, cover replacement flexible connectors with loaded vinyl sheet held in place with metal straps.
- C. Reconnect terminal units to supply ducts with existing flexible ducts or replace damaged and deteriorated existing flexible ducts with maximum 12-inch lengths of new flexible duct.
- D. Reconnect diffusers to low-pressure ducts with existing flexible ducts or replace damaged and deteriorated existing flexible ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- E. Reconnect existing and new flexible ducts to metal ducts. Comply with requirements in Section 23 30 00 "Air Distribution" for flexible ducts.

3.05 RESTORATION

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to current NADCA ACR Standard, "Restoration and Repair of Mechanical Systems" Section.
- B. Restore service openings capable of future reopening. Comply with requirements in Section 23 30 00 "Air Distribution" Include location of service openings in Project closeout report.
- C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section 23 30 00 "Air Distribution".
- D. Replace damaged insulation according to Section 23 07 00 "HVAC Insulation".
- E. Ensure that closures do not hinder or alter airflow.
- F. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.
- G. Reseal fibrous-glass ducts. Comply with requirements in Section 23 3000 "Air Distribution".

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3.06 FIELD QUALITY CONTROL

- A. Gravimetric Analysis: Sections of metal-duct system, chosen randomly by OAR may be tested for cleanliness according to NADCA vacuum test gravimetric analysis.
 - 1. If analysis determines that levels of debris are equal to or lower than suitable levels, system shall have passed cleanliness verification.
 - 2. If analysis determines that levels of debris exceed suitable levels, system cleanliness verification will have failed and metal-duct system shall be re-cleaned and re-verified with no additional cost to OWNER.
- B. Verification of Coil Cleaning: Cleaning shall restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.
- C. Report results of tests in writing.

END OF SECTION

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SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. This Section provides the basic mechanical requirements that apply to the Work of Division 23.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Division 26: Electrical.

1.02 REGULATORY REQUIREMENTS

- A. Materials, fabrication, equipment, and installation shall comply with industry standards and code requirements. Where manufacturer's recommendations exceed industry standards, the manufacturer's recommendation shall establish the minimum standard. As a minimum, standards from the following organizations shall apply:
 - 1. AMCA - Air Movement and Control Association.
 - 2. ANSI - American National Standards Institute.
 - 3. ASME - American Society of Mechanical Engineers.
 - a. ASME Boiler and Pressure Vessel Code.
 - b. ASME B31 - Code for Pressure Piping.
 - 4. AHRI - Air-Conditioning, Heating, and Refrigeration Institute.
 - 5. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers.
 - 6. ASTM - American Society for Testing and Materials.
 - a. ASTM A53 - Specification for Welded and Seamless Pipe.
 - 7. CSA - Canadian Standards Association.
 - 8. FM Global - Factory Mutual Global
 - 9. IAPMO - International Association of Plumbing and Mechanical Officials.
 - 10. NFPA - National Fire Protection Association.
 - 11. OSHA - Occupational Safety and Health Administration.
 - 12. SMACNA - Sheet Metal and Air Conditioning CONTRACTORS' National Association.

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13. UL - Underwriters Laboratories Inc.
 14. Intertek (ETL Certification).
- B. Materials, fabrication, equipment, and installation shall comply with federal, state, and local codes including, but not limited to, the following:
1. CBC, California Building Code, and CMC, California Mechanical Code.
 - a. Latest edition as adopted by the City of Canyon Country, the County of Ventura, and the State of California including amendments effective on the Effective Date of the Contract.
 2. California Code of Regulations, Title 8, Industrial Relations, Division 1, Chapter 4, Division of Industrial Safety.
 3. OSHA - Occupational Safety and Health Administration.
 4. CDPH – California Department of Public Health.
 5. SCAQMD - South Coast Air Quality Management District.
- C. Specifications or Drawings shall not be construed to permit deviation from the requirements of governing codes unless approval has been obtained from legally constituted authorities having jurisdiction, and the Architect. The Contract Documents may contain more stringent requirements than those legally required.
- D. Permits and Fees: Refer to the General and Supplementary Conditions.

1.03 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00: Submittal Procedures and with specific requirements of Division 23 sections, as applicable.
- B. After Architect's approval, the above information shall become the basis for inspecting and testing materials and actual installation procedures performed in the Work.
- C. Shop Drawings: Submit one additional copy when control diagrams having line voltage connections are indicated. Shop Drawings shall be specifically prepared for the Work of this Project. Drawings prepared in accordance with requirements of Section 01 31 13: Project Coordination and Section 01 33 00 may be provided by the Architect to serve as a background for the Shop Drawings. Shop Drawings shall comply with the requirements of Section 01 31 13 and Section 01 33 00 and shall indicate at a minimum:
 1. Complete system layout of equipment, components, ductwork, and piping, indicating service clearances, duct and pipe sizes, fitting types and sizes, top or bottom of duct and pipe elevations, distances of ducts, pipes and equipment from building reference points and hanger / support locations. All the above items shall be coordinated on the shop drawings according to the requirements of Section 01 31 13.
 2. Schedule and description of equipment, ductwork, piping, fittings, valves, dampers, and controllers.

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1.04 PROJECT RECORD DOCUMENTS

- A. Comply with provisions of Section 01 77 00: Contract Closeout.
- B. Project Record Drawings:
 - 1. Provide a complete set of mechanical and control system drawings in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks and plotter pen color/line thickness settings on CD-ROM. Also submit one set of full size reproducible plots on vellum and three sets of prints.
 - 2. Before Contract Completion, deliver corrected and completed prints to the OAR. Delivery of project record documents to the OAR does not relinquish responsibility of furnishing required information omitted from project record documents.
- C. Operation and Maintenance Manuals:
 - 1. Submit operation and maintenance manuals in required form and content. If no revisions are required, furnish one additional copy. If revisions are required, one copy shall be returned with instructions for changes; perform such changes and return manuals. Manuals shall be bound in accordance to Section 01 7700. Deliver manuals to the OAR. Submit an electronic copy of the entire manual in PDF file format.
 - 2. Contents of Manual:
 - a. Title sheet with Project name, including names, addresses and telephone number of CONTRACTOR, installer, and related equipment suppliers.
 - b. Manufacturer's operating instructions including, but not limited to, the following:
 - 1) Identification of components and controls.
 - 2) Pre-start checklist and start-up procedures.
 - 3) Normal operation settings and checklists.
 - 4) Pre-shut down checklist and shut down procedures.
 - 5) Trouble shooting checklist and guidelines.
 - 6) Recommendations for optimum performance.
 - 7) Warnings and safety precautions on improper or hazardous operational procedures or conditions
 - c. Manufacturer's product data and parts and maintenance booklet for each item of equipment furnished under Division 23 that includes the following as a minimum:
 - 1) Manufacturer's model, identification and serial numbers.
 - 2) Exploded view of assembly drawings identifying each component or part with the relevant part number.

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- 3) Directory of manufacturer's representatives, service CONTRACTORS and part distributors.
 - 4) Maintenance and trouble-shooting instructions, including schedule for preventive maintenance, periodic inspection and cleaning criteria.
- d. Project Record Drawings: Complete set of mechanical and control system drawings in 50 percent reduced print format shall be furnished with the manual. Submit the above record drawings on CD-ROM in AutoCAD and, if available, BIM, complete with external reference drawings, fonts, blocks, and plotter pen color/line thickness settings.
 - e. Testing, Adjusting, and Balancing reports: Submit as specified in Section 01 45 25.
 - f. South Coast Air Quality Management District (SCAQMD) permits to install and operate boilers, water heaters and other fuel burning equipment and third-party source test reports as required by SCAQMD to allow start-up and operation of equipment.
 - g. Los Angeles County industrial waste permits.
 - h. Valve directory complete with location, function, size, and model of each valve with reference to the project record drawings.
 - i. Equipment and component identification chart complete with location, function, size, and model of each equipment or component with reference to the project record drawings.

1.05 COORDINATION

- A. Contract Documents indicate extent and general arrangement of Work under Division 23. CONTRACTOR shall coordinate work in accordance with Section 01 3113 requirements and make adjustments as required to provide maximum headroom, a neat arrangement to keep passageways and openings clear to provide accessibility and provisions for maintenance, and to meet code requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Deliver materials to Project site in their original unopened containers with labels intact and legible at time of delivery. Store in strict accordance with manufacturer's recommendations.
- B. Do not store plastic pipe or materials in direct sunlight.

1.07 PRELIMINARY OPERATION

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- A. OAR may require any portion of mechanical Work to be operated before Substantial Completion. Such operation shall be in addition to regular tests, demonstrations and instructions required under the Contract Documents, and shall be performed as required.
- B. Notify the Project Inspector at least 24 hours in advance of lighting or re-lighting pilots.

1.08 TRAINING OF OWNER PERSONNEL

- A. Training of Owner's personnel shall include:
 - 1. A minimum of 8 hours of on-site overview of the overall Mechanical System.
 - 2. Refer to Division 23 sections for specific training on each of the components of the Mechanical System.
 - 3. A minimum of 8 hours of on-site overview identifying location and function of all Control Valves and Actuator assemblies.
 - 4. A minimum of 40 hours of (in classroom) software training for a minimum of 20 OWNER personnel on EMS/BMS if such systems are utilized in the project. Training shall be conducted at control CONTRACTOR training facility with computer setup for each person attending.
- B. Contract shall include the cost of training Owner operation and maintenance personnel in operating, adjusting, maintenance, trouble-shooting, and Project site repair of each component, equipment, or system provided under this Contract.
- C. Operational and maintenance training shall be conducted on the Project site, unless indicated otherwise.
- D. Upon completion of Owner training, a completion certificate indicating the nature of the training and a description of the systems, complete with equipment and component lists shall be issued to each trainee. The certificate should be issued in duplicate with one copy retained by OAR.
- E. An attendance sheet with the names and signatures of all participants attending the training shall be submitted to the OAR and kept as part of the project documents.

1.09 GUARANTEES AND DAMAGE RESPONSIBILITY

- A. Sound of water flowing in piping shall not be transmitted to building structure. Operation of mechanical system shall not produce operational sounds that can be heard outside of rooms enclosing apparatus or equipment.

PART 2 – PRODUCTS

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2.01 MATERIALS AND EQUIPMENT

- A. Unless otherwise specified, materials and equipment shall be new, in good and clean condition. Equipment, materials, and components shall be of the make; type and model number noted on Drawings or specified. Pieces of equipment of the same type shall be by the same manufacturer.
- B. Whenever an item is listed by a single proprietary name, with or without model number and type, it shall be for purpose of design only, to indicate characteristics and quality desired. Proprietary designation listed on Drawings, or listed first in Specifications, is used as a basis for design to establish a standard for quality and performance and space requirements.
- C. HVAC equipment products from different manufacturers are never identical. Equipment approved as being equal is interpreted as being equivalent in capacity, performance and quality. The dimensions, weight, configuration and utility requirements could be quite different from the equipment used as the basis of design. Due to these differences, additional coordination and adjustments by the CONTRACTOR are required. For the equipment to be deemed truly equal, the additional coordination and adjustments by the CONTRACTOR should not incur any additional cost to the Owner and any additional labor to the design team.
- D. Equipment and materials indicated or required to be installed outdoors shall be of the type that is designed, manufactured, listed or approved by authorities having jurisdiction for outdoor installation by being resistant to the adverse effects of weather. All the additional protective measures against outdoor weather required by the manufacturers' installation instructions and prevalent practice shall be provided.
- E. For substitution of materials or products, refer to the General Conditions.

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. CONTRACTOR shall arrange for a preconstruction meeting with IOR prior to the installation of refrigerant piping to discuss installation and testing requirement.

3.02 SERVICE INTERRUPTIONS, OFF-SITE, GAS AND WATER

- A. Schedule Work so there shall be no service interruptions of existing systems or systems during normal hours of operation of affected systems and facilities.
- B. When service interruptions are mandatory, arrange in advance with the OAR as to time and date of such interruptions.
- C. Systems, which are interrupted, shall be returned back into operation in such manner that they will function as originally intended.

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3.03 CUTTING, NOTCHING, AND BACKING

- A. Conform to California Building Code, Title 24, Part 2, for notches and bored holes in wood and for pipes and sleeves embedded in concrete and for cuts in steel, as detailed on structural Drawings.
- B. Where pipes or ducts pass through or are located within one inch of any construction element, install a resilient pad, 1/2 inch thick minimum, to prevent contact.
- C. Furnish all necessary provisions for recesses, chases, and accesses and provide blocking and backing as necessary for proper reception and installation of mechanical Work.

3.04 LOCATION OF PIPING AND EQUIPMENT

- A. Location of piping, apparatus and equipment as indicated on Drawings is approximate and shall be altered to avoid obstructions, preserve headroom, and provide free and clear openings and passageways.
- B. Trenches parallel to footings shall not be closer than 18 inches to the face of footings and shall not be below a plane having a downward slope of 2 horizontal to one vertical, from a line 9 inches above bottom of footing.
- C. Pipe in tunnels shall be installed close to one side of tunnel to provide maximum space for passage. Pipe shall not be installed through crawl hole unless otherwise specified or detailed on Drawings.
- D. Place equipment in locations and spaces indicated, disassemble and/or reassemble equipment as required by Project conditions.

3.05 VALVE AND SPECIALTY APPLICATIONS

- A. Install thermostatic/ electronic expansion valves as close as possible to distributors on evaporators.
 - 1. 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.
 - 2. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- B. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- C. Install moisture/liquid indicators in liquid line near condensing unit.
- D. Install filter dryers in liquid line between compressor and thermostatic expansion valve.
- E. Consult refrigeration equipment manufacturer to determine the need for a receiver.
- F. Install receivers sized to accommodate pump-down charge.
- G. See Evaluations for discussion of flexible connectors.

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- H. Install flexible connectors at condensing unit.

3.06 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 Panels 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 nitrogen must be present and flow in the piping, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing,

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and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

- P. Retain first paragraph and subparagraphs below for steel pipe. Review the cost of steel pipe using these procedures versus the cost of copper piping. Also consider limiting the size of the refrigerant system and its piping to avoid the use of steel pipe.
- Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- R. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- U. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
- V. Identify refrigerant piping and valves according to Division 23 Section "HVAC Identification."

3.07 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- F. Welded Joints: Construct joints according to AWS D10.12/D10.12M.

3.08 TESTS AND TESTING

- A. Tests shall be as required under the applicable sections of Division 23, including this Section.

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- B. Tests required by other sections of the Contract Documents include the following:
1. Test and balance of mechanical equipment and systems: Refer to Section 01 4525: Testing, Adjusting, and Balancing for HVAC.
 2. Hydrostatic test of boilers: Refer to Section 01 4525: Testing, Adjusting, and Balancing.
 3. Test of smoke and fire detectors: Refer to Division 26: Electrical.
- C. Additional tests may be required in the case of products, materials, and equipment if:
1. Submitted items are altered, changed, or cannot be determined as exactly conforming to the Contract Documents.
 2. Performance testing and results may also be required on certain items which are as specified, including fan, and pump performance.
- D. Piping Tests:
1. Perform tests required to demonstrate that operation of mechanical systems and their parts are in accordance with Specifications covering each item or system, and furnish materials, instruments and equipment necessary to conduct such tests. Tests shall be performed in presence of the Project Inspector of Record and Owner Authorized Representative. Work shall not be concealed or covered until required results are provided.
 2. Pressure gages furnished in testing shall comply with CPC. Air shall be bled from lines requiring hydrostatic or water tests.
 3. Systems shall be pressure-tested in accordance with pipe testing schedule below. Pipe test shall indicate no loss in pressure after a minimum duration of 48 hours at test pressures indicated. Where local codes require higher test pressures than specified herein for fire sprinkler systems, local codes shall govern.
 4. Fuel gas lines shall be first tested with piping exposed, before backfilling trenches or lathing; second with piping in finished arrangement, backfilled and paved where required, and walls finished.
 5. Piping systems could be tested as a unit or in sections, but entire system shall successfully meet requirements specified herein, before final testing by the Project Inspector.
 6. Repair of damage to pipes and their appurtenances or to any other structures resulting from or caused by these tests, shall be provided.
 7. Refrigerant piping shall be pressure tested by using a calibrated electronic testing equipment.
 8. Refrigerant Piping Brazing and Deburring Testing procedures for each building:
 - a. OWNER will randomly select maximum Two installed split systems serving each building for the inspection of proper brazing and deburring of associated refrigerant piping systems. Maximum Two copper fittings within the piping systems shall be randomly selected by OWNER and cut and removed by CONTRACTOR for inspection.

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- b. If a sign of oxidation is found on any selected fittings or adjacent piping, then the tested split system piping, and all connected equipment including evaporator and condensing unit with sign of oxidation shall be removed and replaced in entirety by CONTRACTOR at no additional cost to OWNER.
- c. If a burr is found on any selected joint, then the entire tested refrigerant piping system shall be removed and replaced by CONTRACTOR at no additional cost to OWNER.
- d. CONTRACTOR shall repair all tested systems after OWNER's inspection and approval at no additional cost to OWNER.
- e. Inspector of Record shall be present during the replacement of the defective systems and the repair of the tested systems by CONTRACTOR.
- f. If one or more selected split systems fail, then Two additional split systems (not including the ones previously tested) shall be selected for further testing. Selection of additional split systems and retesting will be performed until neither oxidation nor burr is found within the tested systems.

9. Pipe Testing Schedule:

System Tested	Test Pressure (psig)	Test With:
Hot water heating system piping and chilled water piping	150	Water
Refrigeration piping	600	Dry nitrogen

E. Equipment Performance Assurance Tests:

- 1. Before operating any equipment or systems, a thorough check shall be performed to determine that systems have been flushed and cleaned as required and that equipment has been properly installed, aligned, lubricated, and serviced. Factory instructions shall be checked to verify installations have been completed and recommended lubricants have been installed in bearings, gearboxes, crankcases, and similar equipment. Particular care shall be furnished in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Equipment shall also be checked for damage that may have occurred during shipment, after delivery, or during installation. Damaged equipment, products, and materials shall be replaced or repaired as required.
- 2. Upon completion of the above, adjust the system settings to within normal operating conditions to prevent the system from being damaged upon start-up.
- 3. Run-test the equipment after start-up for five consecutive days. Tests shall include operation of heating, ventilating, and air conditioning equipment and systems for a period of not less than two 8 hour periods at 90 percent of the full specified heating and cooling capacities. If equipment passes, install new filters. If equipment fails, it shall be adjusted and retested until system meets all applicable codes.

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4. Equipment Start-up Reports: For each equipment or system on which start-up is performed, submit 8 copies of start-up report for review by the Architect.
 - a. The start-up report shall include the manufacturer's standard start-up form completed and signed by the start-up technician.
 5. Provide, maintain, and pay costs for equipment, instruments, and operating personnel as required for specified tests.
 6. Provide electric energy and fuel required for tests.
 7. Final adjustment to equipment or systems shall meet specified performance requirements.
 8. Equipment, systems, or Work deemed defective during testing shall be replaced or corrected as required. Test until satisfactory results are provided.
- F. Specific Coordinated Plan for Test and Balance:
1. Provide a narrative of the operational intent that clearly describes the function and sequence of operation of each component, equipment, or system installed. Instruct designated Owner personnel in the operation of the installed systems.
 2. Prior to final test and balance, mechanical equipment and systems shall be operated and tested as indicated in Paragraph 3.04.F above to demonstrate satisfactory overall operation of the installed systems.
 3. Immediately before starting tests, air filter media shall be cleaned or renewed. Roll-type filters shall be advanced to provide new clean media. Cleanable type media shall be thoroughly cleaned and re-oiled with new, clean oil as recommended by manufacturer if they are of viscous impingement type. Disposable type filters shall be replaced with new filters. Replaceable media shall be replaced with new media.
 4. An accurate means of measuring air flow and temperatures shall be furnished to balance air supply, return, and exhaust systems so uniform temperatures occur in every room and design airflow is obtained through registers, diffusers, and grilles.
 5. Systems shall be adjusted to provide airflows indicated including maximum fresh air and maximum return air. Dampers shall be checked for proper settings and operation. Air and water inlet and leaving temperatures at coils shall be checked. Complete operational data including airflows, room temperatures, fan speeds, motor currents, plenum, and duct static pressures shall be tabulated.
 6. Welding performed as part of this Division may be subject to radiographic inspections at random in accordance with requirements specified in Section 23 05 13: Basic HVAC Materials and Methods.

3.09 NOISE AND VIBRATION REDUCTION

- A. Correct noise or vibration caused by mechanical systems. Provide all necessary adjustments to specified and installed equipment and accessories to reduce noise to the lowest possible level

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- B. Correct noise or vibration problems caused by failure to install work in accordance with Contract Documents. Include all labor and materials required as a result of such failure. Pay for re-testing of corrected noise or vibration problems by the project acoustical consultant including travel, lodging, test equipment expenses, etc.

3.10 PROTECTION, CARE AND CLEANING

- A. In addition to storage criteria of the General Conditions, and provisions under Section 01 50 00: Construction Facilities and Temporary Controls, the following shall be provided:
1. Provide for the safety and good condition of materials and equipment until Substantial Completion. Protect materials and equipment from damage.
 2. Protect installed Work.
 3. Replacements: In case of damage, immediately provide repairs and/or replacements as required.
 4. Protect covering for bearings, open connections to tanks, pipe coils, pumps, compressors and similar equipment.
 5. Interior of ductwork shall be maintained free of dirt, grit, dust, loose insulation, and other foreign materials.
 6. Air handling equipment shall not be operated until building is cleaned and air filters are installed.
 7. Fixtures, piping, finished brass or bronze, and equipment shall have grease, adhesive, labels, and foreign materials removed. Chromium, nickel plate, polished bronze or brass Work shall be polished. Glass shall be cleaned inside and out.
 8. Before initial start-up and again before Substantial Completion, piping shall be drained and flushed to completely remove grease and foreign matter. Pressure regulating assemblies, traps, strainers, boilers, flush valves, and similar items shall be thoroughly cleaned. Tag system with an information tag listing responsible party and date of element, before initial start-up and again before Substantial Completion. Compressed air, oil, and gas piping shall be blown out with oil-free compressed air or inert gas. Refrigerant piping shall be cleaned as specified.

END OF SECTION

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SECTION 23 05 13 - BASIC HVAC MATERIALS AND METHODS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. This Section prescribes basic materials and methods generally common to the Work of Division 23.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Division 07: Thermal and Moisture Protection: Polyvinyl-Chloride Roofing.
 - 3. Division 23: Heating, Ventilating, and Air-Conditioning.
 - 4. Division 26: Electrical.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01, Section 23 05 00 and specific requirements of each section of Division 23.

1.03 QUALITY ASSURANCE

- A. Standards: Comply with applicable national, state, and local codes and standards: ASTM, ASME, and ANSI. Federal Specifications, AWWA, CISPI, NFPA, FM Global, UL, CPC (California Plumbing Code), CMC (California Mechanical Code), CSA.
- B. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the Architect.

1.04 COORDINATION

- A. Coordinate related Work in accordance with provisions of Section 01 31 13: Project Coordination.

PART 2 – PRODUCTS

2.01 GENERAL

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- A. Provide the following products if they are indicated in the Contract Documents or if they are required for the proper installation, function or operation of equipment, systems or components indicated in the Contract Document.
- B. Provide the following products as a complete assembly with required accessories for a complete and functioning entity in compliance with governing codes and applicable standards as specified in Section 23 05 00, manufacturer's instructions or as required.
 - 1. Omission of minor details in the Contract Documents does not waive and/or otherwise relinquish compliance with the above requirements.

2.02 MANUFACTURERS AND MATERIALS

- A. Ball Valves: Bronze, 2 inches and smaller:

BV-1 Class 150, 600 psi, CWP, 2 piece construction reinforced Teflon seats, full port, adjustable packing gland, stainless ball and stem, threaded ends.

Hammond UP-8303A/UP-8305/UP-8513, NIBCO T-685-80-LF/TS-685-66-LF, Milwaukee UPBA400S/450S, or equal.

BV-2 Class 150, 600 psi CWP, 2-piece construction, bronze body, reinforced Teflon seats, adjustable packing gland, (no threaded stem designs allowed), threaded ends.

Hammond UP8301A, NIBCO T-585-70, Milwaukee BA-400, or equal.

Ball Valves in Insulated Piping: Use extended operating handle of non-thermal conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied. NIBCO Nib-Seal Handle.

- B. Check Valves:

- 1. Bronze, 2-inch and smaller:

CHV-1 Class 125, 200 CWP swing check, Teflon disc, threaded ends. .

NIBCO T-413-Y, Milwaukee 509-T, Hammond IB-940, or equal.

CHV-2 Class 150, 300 psi, CWP, swing check, bronze, Teflon disc, threaded ends:

Stockham B-321; Crane 11TF, NIBCO T-433, Milwaukee 510-T, Hammond IB-946, or equal.

- C. Electronic Flow Readout Meter:

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FM-1 Flow meter shall combine the functions and ranges of several gages into a single board range meter. Meter shall function as a compound pressure gage measuring the high side and low side pressure simultaneously and display each reading in sequence. Meter shall be furnished complete with a shut-off, bypass, and blow down valve network installed on a portable meter panel. A carrying case shall be provided with storage for accessories. Meter shall automatically select the proper range, compensate for temperature, and reset itself. Memory function shall store up to 90 sets of pressure and temperature. Pressure reading shall be accurate to plus or minus 2 percent of reading from 0.01 to 150 psi. Temperature readings shall be accurate to plus or minus 0.5 degrees F and plus or minus 1.0 degree F. from minus 65 degrees F to 250 degrees F. The flow metering device shall be Hydrodata Multimeter HDM-250 as manufactured by Shortridge Instruments Inc., or equal, and shall be furnished with pressure gage, portable meter panel and with valve network, carrying case, battery charger, instruction manual and certificate of calibration, two 6 feet long by 1/2 inch OD pressure hoses with quick disconnects, two 8 foot by 1/4 inch OD drain hoses, and a set of adapters.

D. Gate Valves:

1. Bronze, 2 inches and smaller:

GV-1 Class 125, 200 psi CWP, bronze body and bonnet non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Hammond IB645, Crane 1701, Milwaukee 105, American 3F, NIBCO T-113, or equal.

GV-2 Same as GV-1, except solder ends:

NIBCO S 113, Milwaukee 115, Hammond IB 647, or equal.

E. Liquid Level Gage:

LLG-1 Refrigerant type, carbon steel with stainless steel trim or all forged steel construction, back-seating standard design. Upper and lower valve furnished with ball check valves; 1/2 inch diameter glass on center. Four 3/16 inch diameter gage glass guard rods or slotted steel guard.

Peneberthy, Henry, Conbraco, or equal.

F. Piping:

1. Piping shall be continuously and permanently marked with manufacturer's name, type of material, size, pressure rating, and the applicable ASTM, ANSI, UL, or NSF listing. On plastic pipe, date of extrusion must also be marked.
2. Underground non-ferrous pressure pipes shall be installed with proper color tracer wires. Refer to color code provisions in Section 23 0553: HVAC Identification.

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3. Refer to HVAC Piping: Section 23 20 13 for heating and chilled water piping and fittings.

G. Pipe Isolators:

PLA-1 Absorption pad shall be not less than 1/2 inch thick, unloaded. Pad shall completely encompass pipe.

Holdrite, LSP, Stoneman, Potter-Roemer, Trisolator, PR-Isolator, or equal.

PLA-2 Plastic cushion to form an insulating liner and eliminate metal to metal contact when securing copper tubes and pipes in air conditioning and refrigeration insulation preventing galvanic erosion. (Acoustical Type for Sound Absorption)

Hydra-Zorb Cushion Clamps, LSP Products Group Acousto Clamp, or equal.

- H. Pressure Gage: Aluminum or steel case, minimum 4-1/4 inches dial; pressure type or combination vacuum-pressure type, with provisions for field calibration. Dial indicator to indicate pressure in psi with accuracy to within plus or minus 0.5 percent of maximum dial reading. Furnish gages with restriction screw, size 60, to eliminate vibration impulses. Black case and ring, bourdon tube of seamless copper alloy with brass tip and socket. Three way gage cock, constructed of brass with stuffing box, 1/2 inch couplings, with fixed or movable cap nut to shut off pressure gage.

PG-1 Pressure type, black drawn steel case, 4 1/2-inch glass dial, range approximately twice line pressure.

Marsh Keckley, Trerice, Weksler, Weiss, or equal.

I. Thermometers

1. Industrial:

T-1 Straight type with fixed or ratable stem, extruded or cast brass or cast aluminum case and brass separable well 6 inches minimum scale, angle or straight type range 30 degrees - 240 degrees F.

Weksler, Trerice, Weiss, Ashcroft, Marshalltown, or equal.

T-2 Round type 3 1/2-inch minimum dial range of 100 between 30 degrees and 155 degrees F, color coded red above 150 degrees F. Brass chrome plated case.

Ashcroft, U.S. Gage, Marsh, Weiss, or equal.

2. Remote:

T-3 Liquid-filled capillary type with bulbs as required for remote and insertion mounting dials of 3 1/2-inch minimum diameter, non-ferrous internal parts, external

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means for re-calibration, glass or plastic lens and steel or non-ferrous case suitable for wall, duct or panel mounting range 30 degrees to 240 degrees F.

APPLICATION: PROVIDE FOR MEASURING DUCT, PLENUM, AND OTHER AIR TEMPERATURES.

- J. Unions:
1. Unions shall be furnished and installed in accordance with the following requirements (unless flanges are furnished):
 - a. At each threaded or soldered connection to equipment and tanks, except in Freon or fuel gas, piping systems, whether indicated or not.
 - b. Immediately downstream of any threaded connection to each manually operated threaded valve or cock, and each threaded check valve, yard box or access box except those in Freon piping systems, whether indicated or not.
 - c. At each threaded connection to threaded automatic valves (except those in Freon piping systems) such as reducing valves and temperature control valves, whether indicated or not.
 - d. If grooved piping is used, couplings shall serve as unions. Additional unions are not required
 2. Unions shall be located so that piping can be easily disconnected for removal of equipment, tank, or valve.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this Section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Provide all materials and equipment for the Work. Furnish and install necessary apparatus, parts, materials, and accessories.
- B. Pipe Installation:
1. Install piping parallel to wall and provide an orderly grouping of proper materials and execution.
 2. Piping shall clear obstructions, preserve headroom, provide openings and passageways clear, whether indicated or not. Verify the Work of other Divisions to avoid interference.

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3. If obstructions or the Work of other Divisions prevent installation of piping or equipment as indicated by the Drawings, perform minor deviations as required by the Architect.
4. Install piping after excavation or cutting has been performed. Piping shall not be permanently enclosed, furred in, or covered before required inspection and testing is performed.
5. Exposed polished or enameled connections from fixtures or equipment shall be installed with no resulting tool marks or threads at fittings. Residue or exposed pipe compound shall be removed from exterior of pipe.
6. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members, provide such members with reinforcement steel straps of Continental Steel & Tube Co., ULINE, Independent Metal Strap, or equal.
7. Reduce fitting where any change in pipe size occurs. Bushings shall not be furnished unless specifically reviewed by the Architect, or indicated on Drawings.
8. Piping subject to expansion or contraction shall be anchored in a manner, which permits strains to be evenly distributed. Swing joints or expansion loops shall be installed. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping. Seismic loops required at all building separations.
9. Immediately after lines have been installed, openings shall be capped or plugged to prevent entrance of foreign materials. Caps shall be left in place until removal is necessary for completion of installation.
10. Couplings shall not be installed except where required pipe runs between other fittings are longer than standard length of type of pipe being installed and except where their installation is specifically reviewed by the Architect.
12. Water lines may be installed in same trench with sewer lines, provided bottom of water line is 12 inches minimum above top and to the side of sewer line.
14. Changes in pipe sizes shall be furnished with eccentric reducers, flat on top. Offsets to clear obstruction shall not be installed so as to produce air pockets.

C. Pipe Sleeves and Plates:

1. Provide and install pipe sleeves of Schedule 40 black steel pipe or Schedule 40 PVC plastic pipe in concrete or masonry walls, footings, and concrete floors below grade. Provide and install adjustable submerged deck type sleeves at locations where pipes pass through concrete floors, except

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concrete slab floors on grade, and at locations where soil pipe for floor type water closets passes through concrete floors.

FOR FIRE RATED WALL PENETRATIONS FOLLOW THE CALIFORNIA Building Code.

2. Sleeves shall provide 1/2 inch clearance around pipes, except plastic pipe shall have 1-inch clearance. Caps of deck type sleeves shall be removed just prior to installation of pipe. Area around sleeves shall be smooth and without high or low spots. Sleeves in walls shall not extend beyond exposed surface of wall. Sleeves in concrete floors and walls shall be securely fastened to forms to prevent movement while concrete is being placed.
 3. Piping installed on a roof shall clear the roof surface by 10 inches minimum, with or without insulation. Bottom of individual fittings may infringe on 10 inches clear space but not groups of fittings or fittings located within 27 inches of each other.
 4. Stiles shall be provided to facilitate crossing of piping when parallel piping runs are laterally greater than 12 inches out-to-out, or any pipe is higher than 18 inches, and more than 40 feet long or runs between 2 or more major pieces of equipment or housings greater than 20 feet apart. Stiles shall be not less than 20 inches wide with a minimum tread depth of 10 inches. Where stiles are required, they shall be located so greatest obstructed distance is 30 feet.
 5. Where pipes pass through waterproofed walls, floors, or floors on grade, sealant with Link-Seal Modular Seals, or equal, between pipe and sleeve to provide a waterproof joint. Where earth is in contact with pipe on both sides of a wall or foundation, the waterproof joint is not required. Commercial rubber compression units may be furnished instead of sealed sleeves if reviewed by the Architect.
 6. A swing joint, or other required device, shall be furnished and installed in hot water lines with 10 feet of sealant or compression joint to allow for expansion.
 7. Pipe sleeves shall be provided where pipes intersect footings or foundation walls and sleeve clearances shall provide for footing settlement, but not less than one inch all around pipe.
- D. Welding of Pipe and Qualifications of Welder:
1. Joints above grade or accessible conduit or tunnels in steel piping may be either welded or screwed unless specifically indicated otherwise on Drawings or specified. Joints in below grade steel piping, whether in insulation or not, shall not be welded, unless otherwise indicated.

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2. Welded joints in pipe shall be continuous around pipe and shall comply with ASME B31: Code for Pressure Piping, unless otherwise specified.
3. Each pipe weld shall be stamped with welder's identification mark. Welding shall be performed by welders possessing a valid certificate of qualification for welding carbon steel welding pipe in horizontal position (2G) and horizontal fixed position (5G) in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code, by an Owner-recognized, DSA approved testing laboratory.
4. Before any welder performs welding on the Work, furnish the Project Inspector with a copy of welder's valid qualification papers and obtain verification. Welder qualification is not valid unless it has been issued while welder was performing work for current employer, and has performed type of work described by qualification in the preceding 3 months.

REFERENCE: ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-29 TESTS OF WELDERS AND WELDING OPERATORS.

5. Welding performed under these Specifications is subject to special tests and inspections including rigid Ultra Sonic Testing (UT) and radiographic inspection at random, in accordance with Technique for Radiographic Examination of Welded Joints by an Owner recognized, DSA approved testing laboratory.

ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-51 RADIOGRAPHIC EXAMINATION OF WELDED JOINTS.

E. Unacceptable Welds and Repairs to Welding:

1. Welds containing any of the following types of imperfections shall be deemed defective Work:
 - a. Cracks of any type.
 - b. Zones of incomplete (in excess of 1/32 inch) fusion or penetration.
 - c. Elongated slab inclusions longer than 1/4 inch.
 - d. Groups of slag inclusions in welds having an aggregate length greater than thickness of parent metal in a length 12 times the thickness of the parent metal.
 - e. Undercuts greater than 1/32 inch.
 - f. Overlaps, abrupt ridges or valleys.

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2. When a defective weld is detected by examination as outlined above, two additional welds shall be radiographed at locations selected by the Project Inspector. If the two selected welds demonstrate compliant welding, then the two tested welds shall be deemed to be in compliance. Welding revealed by radiographs to be defective Work shall be removed, repaired, and tested by radiograph.
3. If either of the two selected welds demonstrates welding deemed to be defective Work, all welding in that portion of the Work shall be deemed defective Work and either: all welds shall be cutout, prepare new ends for welding and weld to comply with this Specification, or radiograph all welds, removing and repairing only such welding deemed to be defective Work.
4. Repair welding shall be performed in a manner in full compliance with ASME B31. The welded joints or repairs shall be spot examined with UT or radiographic tests in accordance with foregoing requirements.

REFERENCE, ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-52.

5. Owner shall cause to be performed additional random UT and radiographic examinations of welds. Owner shall be responsible for the costs of any UT and radiographic examinations found to be in compliance with specified requirements.
 6. Installer shall be responsible for the costs of UT and radiographic re-examinations of welds deemed defective Work and not in compliance with this Specification, and shall repair or replace said welds in accordance with specified requirements.
- F. Welding Rods: Submit a written list of materials and proposed type of welding rods for review by the Architect.
- G. Backing Rings: Backing rings may be submitted for installation provided the Product Data is submitted with the material list.
- H. Qualification Tests for Low-pressure Welding:
1. Tests shall be performed on 3-inch standard weight pipe ASTM A53, Grade A, and shall be welded by acetylene and electric arc. Each sample shall consist of two pieces, each 10 inches long, with 30-degree bevel at point weld.
 2. Two 20-inch samples shall be performed in the 2G and two 20-inch samples in the 5G positions, with positions defined in Section IX, ASME Boiler and Pressure Vessel Code. Welds shall have the reinforcement ground or machined flush to the surface of the pipe before testing. Samples shall be tested as full section tensile.

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3. Weld shall develop a load of 90 percent of 50,000 psi, i.e., 45,000 psi or shall develop a fracture in parent metal.
4. Each qualified welder shall carry an identification card listing welder's name, date of test, and type of welding tests passed; signed by the welder and the laboratory.
5. A valid certificate of qualification issued in compliance with requirements of the ASME Boiler Pressure Vessel Code Section IX shall qualify a welder for issuance of a certificate for low-pressure pipe welding.

I. Certificates of Qualification for Welding of Unfired Pressure Vessels:

1. Certificates of qualification shall be issued by a laboratory recognized by the Owner in compliance with the requirements of the ASME Boiler Pressure Vessel Code Section IX. Qualifications shall be for both acetylene and arc welding of Schedule 40 ASTM A53, Type B, steel welded or seamless pipe in the Horizontal Position (2G) and the Horizontal Fixed Position (5G) as defined by said code.

NOTE: Certificate described above is not valid unless it has been issued while welder was working for his current employer, and unless welder has performed type of work described by certificate in the preceding three months.

Requirements for possession of a valid certificate shall not be waived for welders fabricating unfired pressure vessels when the Specifications require compliance with ASME code or when welding pipe carries working pressures greater than 75 psi and temperatures greater than 250 degrees F.

J. Pipe Joints and Connections:

1. Pipe and tubing shall be cut per IAPMO Installation Standards. Pipe shall have rough edges or burrs removed so that a smooth and unobstructed flow shall be provided.
2. Threaded Pipe: Joints in piping shall be installed according to the following service schedule:
 - a. Refrigerant and Soap Piping: Litharge and glycerine, or Expando, Gasoila, or equal.
 - b. All other services Furnish sealant, suitable and as reviewed by the Architect.
3. Threads on pipe shall be cut with sharp, clean, unblemished dies and shall conform to ANSI/ASME B1.20.1 for tapered pipe threads.
4. Joint compounds shall be smoothly placed on male thread and not in fittings. Threaded joints shall be installed tight with tongs or wrenches and sealant of any kind is not permitted. Failed joints shall be replaced with new materials.

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Installation of thread cement or sealant to repair a leaking joint is not permitted.

5. Sharp-toothed Stillson, or similar wrenches, is not permitted for the installation of brass pipe or other piping with similar finished surfaces.
- K. Copper Tubing and Brass Pipe with Threadless Fittings:
1. Silver brazed joints shall be used for attaching fittings to non-ferrous metallic refrigerant piping.
 2. Non-pressure gravity fed condensate lines may be soldered with 95/5 solder.
 3. Silver brazing alloy, Class BCUP-5. Surfaces to be joined shall be free of oil, grease, and oxides. Socket of fitting and end of pipe shall be thoroughly cleaned with emery cloth and wiped to remove oxides. After cleaning and before assembly or heating, flux shall be installed to each joint surface and spread evenly. Heat shall be applied in accordance with instructions in the Copper Tube Handbook issued by Copper Development Associates. Joints constructed of rough bronze fittings shall be provided as recommended by manufacturer.
 4. Do not overheat piping and fittings when installing silver brazing.
 5. Joints in non-ferrous piping for services not covered above shall be installed with solder composed of 95/5 tin/antimony, ASTM B32, Grade 5A. Surfaces to be jointed shall be free of oil, grease, and oxides. Sockets of fitting and end of pipe shall be thoroughly cleaned with emery cloth to remove oxides. Solder flux shall be sparingly installed and solder added until joint is completely filled. Do not overheat. Excess solder, while plastic, shall be removed with a small brush in order to provide an uninterrupted fillet completely around joint. Random inspection of joints shall be conducted by Project Inspector to ensure joints are lead-free.
 6. Grooved end joints for copper piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
- L. Ring-Type Pipe: Joints shall be installed in accordance with manufacturer's instructions with grooved couplings, fittings and rubber rings. Couplings and pipe shall be compatible and of the same manufacturer. Rings shall be accurately located and installed by grooves in coupling. Pipe shall be installed with zero deflection unless otherwise specified. Pressure pipe shall be furnished with thrust blocks at each offset point.

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- M. Welded Pipe Joints:
1. Joints in welded steel pipelines shall be installed by oxyacetylene or electric arc process. Welding shall be continuous around pipe and provided as specified.
 2. Butt welds shall be of the single V-type, with ends of pipe and fittings beveled approximately 37 ½ degrees. Piping shall be aligned before welding is started with the alignment maintained during welding.
 3. Welds for flanges and socket fittings shall be of the fillet type with a throat dimension not less than pipe wall thickness.
- N. Grooved End Pipe Joints: Grooved end joints for carbon steel piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to grove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.
- O. Joints shall be Vic-Press 304TM, or equal, made with Victaulic Series 'PFT' tools and the appropriate sized jaw. Pipe shall be certified for use with Vic-Press 304TM system, and shall be square cut, properly deburred and cleaned, and marked at the required location to insure full insertion into the fittings and/or couplings.
- P. Valves: Valves shall conform to the following:
1. Piping systems shall be furnished with valves at points indicated on Drawings and specified, arranged to provide complete regulating control of piping system throughout building and the Project site.
 2. Valves shall be installed in a neat grouping, so that parts are easily accessible and maintained.
 3. Pressure Independent Characterized Control valve type shall be suitable for service on which installed.
 4. Valves shall be full size of line in which they are installed, unless otherwise indicated on Drawings or otherwise specified, and shall be one of types specified.
 5. Provide chain operators on valves 2-inch and larger located 7 feet or more above the servicing floor level.
 6. Valves for similar service shall be of one manufacturer.
 7. Except where otherwise specified, valves shall be Belimo, Victaulic, Stockham, Crane, Jenkins, Milwaukee, Hammond, American Valve, NIBCO, Hoffman, or equal.

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8. Ball valves below grade in yard boxes shall have stainless steel handles.
 9. Temperature relief valves and combination temperature and pressure relief valves shall be as specified and furnished as set forth in this Section. Discharge pipe from relief valves shall be not less than discharge area of valve or valves it connects, based on discharge area of valves, and shall terminate as indicated and free of any traps. Valves shall be installed at following locations:
 - a. A combination temperature and pressure relief valve or combination of valves on each heating hot water boiler. Temperature sending element shall extend into water inside boiler.
 10. Manual air vent valve assemblies shall be installed at each high point of hot water space heating and chilled water piping systems. Valves shall discharge through 1/4 inch diameter copper tubing and drain to nearest floor sink. Automatic type air vent valve shall only be installed where specifically indicated. Radiator, convectors, and finned pipe convectors shall be fitted with packless radiator valves, angle or straight pattern. Each convector or radiator installed as part of a space hot water heating system shall be furnished with a manual-type air vent valve.
- Q. Strainers: Strainers shall be installed on each water main (except for fire line) downstream of the meter, above grade, when a pressure regulator assembly is not installed. Main strainer shall be of Y-flange or groove type. On closed loop chilled and heating hot water systems pump systems, a strainer shall be installed at each pump inlet and upstream of each flow control valve assembly. The control valve assembly may include a modulating temperature control valve and a flow-limiting valve, manufactured by Griswold, AutoFlow, Flow Control Industries, Inc., or equal.
- R. Hangers and Supports:
1. Piping shall be securely fastened to building structure by approved iron hangers, supports, guides, anchors, and sway braces to maintain pipe alignment to prevent sagging and to prevent noise or excessive strain on piping due to uncontrolled or seismic movement under operating conditions. Hangers and supports shall conform to Manufacturer's Standardization Society Specification SP-69. Hangers shall be relocated as required to correct unsatisfactory conditions that may become evident when system is placed into operation. Appliances, heat exchangers, storage tanks, and similar equipment shall be securely fastened to structure in accordance with seismic requirements. Outdoor metal hangers and supports shall be hot-dipped galvanized steel, unless otherwise specified.
 2. Piping shall not be supported by wire, rope, wood, plumbers' tape, or other non-recognized devices.

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3. Hangers and supports shall be designed to support weight of pipe, fittings, weight of fluid and weight of pipe insulation, and shall have a minimum factor of safety of 5, based on ultimate tensile strength of material installed.
4. Burning or welding of any structural member under load is not permitted. Field welding not specified on Drawings or reviewed Shop Drawings is not permitted without review by Architect and DSA.
5. Burning holes in beam flanges or other structural members is not permitted without review by the Architect and DSA.
6. Pipe hangers on piping covered with low temperature insulation shall be installed on outside of insulation and not in contact with pipe unless otherwise detailed on Drawings. Insulation shall be protected by 18 gage galvanized steel shield, with a minimum length of 10 inches, installed completely around pipe covering between covering and hanger. Installing hangers directly on pipe and butting adjoining sections of insulation against hanger is permitted provided void and hanger rod are properly insulated and sealed so that no sweating occurs at hangers.
7. Hanger rods shall be fastened to structural steel members with suitable beam clamps. Clamps shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco I beam, Fig.62 for maximum 1000 lbs.
 - b. Tolco I or WF beam, Fig. 329, for maximum of 1290 lbs.
8. Hanger rods shall be fastened to concrete inserts in concrete slabs or beams. Inserts shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:
 - a. Tolco Fig.310 for maximum of 600 lbs.
 - b. Tolco Fig. 309 for maximum of 1140 lbs.
9. For fastening to wood ceilings, beams, or joists, furnish Anvil Fig. 128R, Anvil Fig. 153, Tolco 78, or equal pipe hanger flange fastened with drive screws. Under wood floors, 3/8 inch hanger rods shall be hung from 2-inch by 2-inch by 1/4 inch angle clips 3-inch long, with two staggered 10d nails, clinched over joist.
10. Hanger rod sizes for copper, iron, or steel pipe: 3/8 inch for pipe sizes 1/2 inch through 2-inch, 1/2 inch for pipe sizes 3-inch, 4-inch and 5-inch, 5/8 inch for pipe size 6-inch, and 3/4 inch for 8-inch and 10-inch pipe.
11. Turnbuckles, if furnished, shall provide a load carrying capacity equal to that of the pipe hanger with which they are being installed.

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12. Pipe hangers shall be of same size, or nearest larger manufactured size available, as pipe or tubing on which they are being installed.
13. Hangers, clamps, and guides furnished for support of non-metallic pipe shall be padded with 1/8 inch thick rubber, neoprene, or soft resilient cloth.
14. Where special pipe-supporting requirements in the Specifications conflict with any standard requirements specified herein, the Specification requirements shall govern.
15. Vertical Piping:
 - a. Vertical pipe risers shall be securely supported with riser clamps of recognized type. Risers in reinforced concrete buildings shall be furnished with extension clamps fastened to pipe above each concrete floor slab with extended arms of clamp to rest on slab. Clamps shall be provided with lead or Teflon liners when installed on copper tubing. Clamps shall be plastic-coated when installed on non-ferrous pipe or tubing.
 - b. Copper tubing in sizes 1 ½-inches and larger and steel pipelines passing up through building shall be supported at each floor of building or every 15 feet whichever is less.
 - c. Copper tubing sizes 1 ¼-inch and smaller shall be supported at not intervals not more than 6 feet on center. Special provisions shall be installed for vertical lines subject to expansion and contraction caused by operating temperature differences.
 - d. Vertical cast iron pipelines shall be supported from each floor and at its base. Malleable iron or steel pipe clamps with minimum thickness of 1/4 inch shall be furnished and fastened around pipe for support.
16. Horizontal Piping:
 - a. Roof Mounted Piping: Pressure and non-pressure piping shall be supported from channels, stands, clamps, trapezes, rollers, or structures mounted on 100% rubber, UV resistant rooftop supports with reflective strips, Dura-Block, or equal. Roller type supports shall be provided below and above pipe to prevent its dislodgement. Bottom of pipes shall clear the roof surface by 10 inches.
 - 1) At PVC roofing provide walk tread, polyester reinforced, UV resistant, with surface embossment at rooftop supports. Heat welding of walk pads shall only be done by manufacturer certified installers.

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- a)
 - a) Sika-Sarnafil and Carlisle: Walk tread shall be no more than one inch larger than the plan area of the pipe support blocks and adhered to the roof membrane with Sika 1A or Carlisle Universal Single-Ply sealant, as applicable.
 - b) Johns Manville: Walk tread shall be installed under the pipe support blocks and adhered to the blocks, if possible, and left loose laid on top of the PVC roof system. Walk-pad shall have a minimum of 4 inches of material past perimeter on all 4 sides of block.
 - 2) Built-up roofing: Provide APP granulated modified torch-down at each pipe support block. Torch-down shall extend 2 to 4 inches beyond the edges of the block and adhered by torch application over existing cap sheet membrane. This work shall be performed by a certified roofer.
- b. Piping Mounted to Underside of Roof and Decks and from Structure:
1. Insulated steam and space heating hot water supply and return piping shall be supported with Tolco Figure 4, B-Line Figure B3140, Anvil Figure 212, or equal, steel hangers with welded eye rods to permit hinge movement at point of attachment of hangers. Hinge movement at point of support shall be provided by welded eye linked rods Tolco Figure 101L, B-Line Figure B3211X, Anvil Figure 278X, or equal.
 2. Chilled water supply and return piping, condenser water piping, insulated refrigerant piping may be supported with Tolco Figure 1, B-Line Figure B3100, Anvil Figure 260, or equal, hangers with rods, turnbuckles and inserts suitable for above hangers.
- c. Maximum hanger and support spacing shall conform to CPC schedule for horizontal piping installed above grade.
17. A hanger or support shall be installed close to the point of change in direction of a pipe run, in either a horizontal or vertical plane.
 18. When practicable, supports and hangers for cast iron soil pipe shall be installed as close as possible to joints and when hangers or supports are not located within one foot of a branch line fitting, an additional hanger or support shall be installed at fitting.
 19. In systems where grooved piping is used, couplings shall be provided with angle pattern bolt pads to comply with support and hanging requirements of ANSI/ASME B31.1, ANSI/ASME B31.9, and NFPA Pamphlet 13.

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S. Flashings:

1. Each pipe, duct, or gas-fired equipment vent passing through roof shall be installed with waterproof flashing.
2. Flashing or flanges on pipes, vents, and ducts passing through a tile or slate roof shall be constructed of sheet lead. Flashing for pipes and heater vents passing through a roof shall be 4 pound soft sheet lead. Flashing and flanges for ducts and heater vents passing through exterior walls shall be 22 gage sheet metal. Flanges and flashing shall be installed waterproof at point of connection with pipe or duct. No soldered joints on roof flashings will be allowed.
3. Lead flashing and flanges shall be constructed of 4 pound sheet lead with burned joints. Flange of lead flashing or lead flange on a duct shall extend out onto roof a minimum of 12 inches from pipe or duct. Lead flashing shall extend up the pipe or duct not less than 7 inches.
4. Sheet metal flashing shall be constructed of 24 gage galvanized sheet steel. Flanges on these flashings shall extend out onto roof a minimum of 10 inches from pipe or duct. Flanges on ducts through exterior walls shall extend out from duct a minimum of 2 ½ inches. Flanges on gas-fired equipment single-wall vents shall be of ventilated type. Type B gas vents through a roof shall be furnished with non-ventilated flashing as per NFPA Pamphlet 211.
5. Cast iron, steel, brass, and copper pipe, which terminate less than 18 inches above roof, shall be furnished with a combination counter-flashing and vandal-proof hood for protection against water, birds and foreign matter. Cast iron, steel, brass and copper pipe, which does not terminate within 18 inches of roof, shall be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with protection against entrance of water, birds, and foreign matter.
6. Counter-flashing and combination counter-flashing sleeves and vandal-proof hoods shall be cast iron, vandal-proof, threaded, sealed or approved gas-heated sleeve type. Counter-flashing sleeves on each of these items shall extend down over flashing a minimum of 3/4 inch.
7. Flashing and flanges on ducts shall be installed waterproof at point of connection to the duct by riveting and soldering. Storm collars shall be securely screwed and installed waterproof around appliance vent pipe immediately above flashing.
8. Vent piping above roof shall be furnished with a combination counter-flashing sleeve and vandal-proof hood.

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- T. Equipment Installation: Install roof or floor mounted equipment on level platforms, housekeeping pads or curbs and provide sound, vibration and seismic control measures per Section 23 05 48, unless indicated otherwise whether indicated on drawings or not.

END OF SECTION

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SECTION 23 05 48 - HVAC SOUND, VIBRATION AND SEISMIC CONTROL

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Reduction or elimination of excessive noise or vibration within building due to operation of equipment, machinery, piping, and ductwork as specified.
 - 1. Vibration isolators.
 - 2. Seismic restraint devices.
 - 3. Duct silencers.
 - 4. Acoustic housings.
 - 5. Lining and enclosing ductwork.
 - 6. Acoustic louvers.
 - 7. Sound attenuation boots at supply, return, exhaust and transfer air inlets, outlets and openings.
 - 8. Flexible ducts, conduits and piping.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 01 45 25: Testing, Adjusting, and Balancing for HVAC.
 - 3. Section 23 05 00: Common Work Results for HVAC.
 - 4. Section 23 05 13: Basic HVAC Materials and Methods.
 - 5. Section 23 30 00: Air Distribution.
 - 7. Section 23 38 13: Kitchen Ventilation System.
 - 8. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.

1.02 GENERAL REQUIREMENTS

- A. Provide vibration isolators to eliminate or reduce the transmission of vibration noise to any part of building and mitigate vibration frequency and load imposed by equipment. Vibration isolators, base frames, inertia bases and seismic restraints shall be of sufficient size, flexibility and load distribution configuration to assure that deflection,

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stability and seismic restraint requirements are met without permitting excessive movement when starting. For typical units, no fewer than four isolators shall be provided. Isolators shall be provided to deflect uniformly under operating gravity and equipment thrust loadings to within plus or minus 10 percent of specified deflection values.

- B. Static deflections specified are based on the anticipated equipment characteristics. In the event the equipment proposed by the Contractor has characteristics other than those indicated, particularly the rated rpm, the static deflection shall be re-evaluated and the proper mountings and other devices shall be provided.
- C. Where fabricated vibration isolator units are indicated, furnish manufacturer's standard catalog products with printed loading ratings or certified submittals
- D. Seismic Requirements:
 - 1. Refer to Seismic Restraint Manual: Guidelines for Mechanical Systems, published by SMACNA and approved by DSA, for minimum seismic restraints required on mechanical components design and construction details.
 - 2. Provide seismic restraints for mechanical equipment or components specified. Where equipment is specified with proprietary names, design for seismic restraints is for first proprietary name listed.
 - 3. Provide restraints, bracing and anchorage as required for the mechanical equipment, electrical equipment and components specified in the Contract Documents. Restraints, bracing and anchorage shall be installed to resist the total design earthquake or wind loads in any direction in accordance with CBC and SMACNA guidelines.
 - 4. Provide restraints, bracing, and anchorage for the mechanical equipment and components.
 - 5. For rigidly mounted liquid filled steel pipe, comply with the following:
 - a. Provisions of NFPA Pamphlet 13, section for sway bracing.
 - b. Provisions of NFPA Pamphlet 13, section for earthquake protection.
 - c. Hanger spacing as specified in Section 23 05 13 under Hanger Spacing Schedule.
 - d. SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems and approval by DSA.
 - 6. For flexibly mounted liquid filled steel pipe, comply with the following:
 - a. Provisions of the California Building Code for flexibly mounted equipment.

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- b. Provisions of VISCMA (Vibration Isolation and Seismic Control Manufacturer's Association) Seismic Control Device Installation, Best Practices Manuals.
 - c. Installer may provide a DSA or OSHPD approved system such as the SMACNA Seismic Restraint Manual with Addendum No. 1, the Mason Industries Seismic Restraint Guidelines or other proprietary pre-approved system.
7. For ductwork and other mechanical equipment restraints, comply with SMACNA Seismic Restraint Manual: Guidelines for Seismic Mechanical Systems and obtain approval by DSA.

1.03 SUBMITTALS

- A. Provide in accordance with Division 01.
 - 1. Catalog cuts and data sheets on specific vibration isolators, seismic restraints, and anchors demonstrating compliance with the Specifications.
 - 2. Shop Drawings for each piece of equipment including dimensions, structural member size, support point, vibration, and seismic restraints.
 - 3. Written approval of frame design to be furnished by the equipment manufacturer.
 - 4. Drawings indicating methods for suspension, support, seismic restraints, guides, etc., for piping, ductwork, etcetera.
 - 5. Drawings indicating methods for isolation of pipes, ducts etcetera, piercing slabs, beams, etcetera.
- B. Vibration Test Reports: At completion of installation, submit the following documents. Submission of these documents must be complete before final acceptance of vibration isolation systems is given. Assistance from the vibration isolation equipment Manufacturer may be required.
 - 1. Complete tabulation showing for each vibration isolator:
 - a. Actual static deflection measured at the project.
 - b. Specified minimum static deflection.
 - 2. Report certifying:
 - a. Each piece of operative rotating mechanical equipment does not exceed the specified vibration displacement level.

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- b. Each piece of isolated equipment or equipment component (ducts, pipes, conduit, etcetera) is not short-circuited by any means.
- c. Requirements of Part 2 are satisfied for equipment.

1.04 QUALITY ASSURANCE

- A. Standards and Codes: Comply with applicable codes and standards having jurisdiction including, but not limited to:
 - 1. NFPA, Pamphlet 13.
 - 2. ASHRAE Handbook: HVAC Systems and Equipment.
 - 3. SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems.
 - 4. California Building Code.
 - 5. VISCMA
 - a. Installing Seismic Restraints for Mechanical Equipment.
 - b. Installing Seismic Restraints for Duct and Pipe.
- B. Qualifications of Manufacturer and Installers: Comply with provisions as set forth in Section 23 0500: Common Work Results for HVAC.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Furnish and install vibration dampers, sound isolation pads, flexible connections and similar equipment required to prevent sound of water flowing in pipes, vibration of motors, and motor operated equipment from being transmitted to building structure; and, in case of fans, from being transmitted along ducts. Piping shall be isolated from vibrating equipment by furnishing required flexible connectors.
- B. Pumps and similar motor operated equipment shall be installed on anti-vibration units.
- C. Fans, except curb-mounted roof-type exhaust fans and wall mounted propeller fans, shall be installed with anti-vibration units, whether indicated on Drawings or not. Fans built into air handling units may be furnished with independent anti-vibration mountings or whole unit may be installed on an external vibration isolation system.
- D. Other equipment shall be installed on anti-vibration bases, pads, or hangers, unless specifically noted otherwise on Drawings. Package units, furnished with built in anti-vibration bases, do not require unit bases unless otherwise specified.

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1. Unless specified otherwise, anti-vibration bases shall be Mason Industries, M.W. Sausse & Co., the VMC Group, or equal, of the Model Number specified or indicated on the drawings. Furnished base including sub-base, shall be manufactured by same company with fan and integral motor base. Seismic restraints may be incorporated into bases or furnished separately.
2. Inertia anti-vibration bases shall conform to requirements indicated.
3. Unless noted otherwise, furnished anti-vibration bases, including supporting units for inertia bases, shall be of the spring type.
4. Selection of bases or supporting units shall be in accordance with manufacturer's recommendations based on following installed minimum effective isolation efficiencies (where not provided with each piece of equipment):
 - a. Centrifugal fans, packaged fan and coil units and cooling towers, less than 800 RPM 80 percent
 - b. Centrifugal fans over 800 RPM 90 percent
 - c. Centrifugal pumps 95 percent
 - d. Reciprocating compressors 95 percent
- E. Flexible duct connections shall be provided at inlet and outlets of each fan or HVAC unit, except curb-mounted roof exhaust fans whether indicated on the drawings or not.
- F. Flexible pipe or conduit connections shall be provided at piping and conduit connections to HVAC units, pumps, compressors and other moving (reciprocating or rotating) mechanical or electrical equipment provided under this Section whether indicated on the drawings or not.
- G. Flexible connections for Freon piping shall be seamless flexible metal hoses of type and length recommended by manufacturer and suitable for system operating pressure.
- H. Flexible connections for all other piping shall be flexible metal hose or spool type with flanged ends, unless otherwise specified. Metal hose shall be covered with protective braiding in areas where physical abrasion may occur, or for personnel safety.
- I. Spool types shall be similar to American Rubber Co., Mercer Rubber Co., PROCO Products, Inc., or equal, and hose types shall be similar to DME, Inc., U.S. Flex, Pennflex, Anaconda Flexpipe, Keflex, or equal with any required modifications to meet specified requirements. Flanges shall be furnished with steel retaining rings. Units installed on discharge side of pumps shall be furnished for a suitable working pressure of not less than 100 psig, and those on suction side for working pressures of 50 psig or 30 inches Hg vacuum.
- J. Units installed in cold water lines (less than 125 degrees F) shall furnish a minimum temperature rating of 180 degrees F and those installed in hot water lines (above 125 degrees F) shall be constructed of special heat resistant materials and be furnished for

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a minimum temperature rating of 220 degrees F, continuous operation. Units shall be able to withstand a maximum lateral deflection of 3/8 inch. Temperature and pressure ratings shall be molded into body of each spool unit so they are easily identified. Spool types shall be for straight in flow only.

- K. Spool type units shall be furnished with control units comprised of a minimum of two tie-rods and anchor plates or internal guide sleeves to prevent excessive elongation or misalignment. Rubber washers shall be provided under bolt heads and rubber grommets in bolt holes to prevent any metal to metal contact between bolts and flanges.
- L. Where hose type units are furnished, restraining anchors or braces shall be provided if excessive or undesirable pipe movement occurs when system is operated.

2.02 GENERAL PROPERTIES OF VIBRATION ISOLATORS.

- A. Shall be provided with markings so that, after adjustment, when carrying their load, deflection under load can be verified; thus determining that load is within proper range of device and that correct degree of vibration isolation is being provided according to the design.
- B. Isolators to operate in direct proportion to their load versus deflection curve. Load versus deflection curves shall be furnished by manufacturer and must be linear over a deflection range of 50 percent above design deflection.
- C. Wave motion through isolator shall be reduced to following extent: Isolation above resonant frequency shall follow theoretical prediction based upon an un-dampened single degree of freedom system with a minimum isolation of 50 decibels above 150 cycles per second.
- D. Vibration isolator spring diameters shall be no less than their deflected height. Furnish spring with a 50 percent overload safety factor.
- E. Unless otherwise indicated, equipment installed on vibration bases shall provide a minimum operating clearance of one inch between structural steel base and floor or support base. Provide flexible connectors in piping and flexible conduit in power wiring to minimize transmission of vibration.
- F. Isolators and springs exposed to weather shall be hot-dipped galvanized or powder coated after fabrication and before installation. Hot-dipped zinc coating shall be not less than two ounces per square foot by weight complying with ASTM A123. In addition, provide limit stops to resist wind velocity.
- G. Where indicated, provide structural steel bases with height saving brackets, and minimum of three points of support. Isolators shall be furnished with a method for leveling.
- H. Design isolators and seismic restraints for positive anchorage against uplift and overturning.

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- I. Provide and install, under this Section of the Specifications, structural steel required to properly support equipment and steel required to support horizontal thrust arrestors.

2.03 ISOLATOR TYPES

- A. Type A: Steel Spring Isolators: Un-housed steel spring isolators, laterally stable and unrestrained. Design springs so that ratio of horizontal to vertical spring (stiffness) constant is between 0.9 and 1.3. Natural frequency of isolator must be 1/3 to 1/4 of driving frequency that is to be controlled. Isolators to provide a minimum additional travel to solid equal to 50 percent of rated deflection. Isolators shall be furnished with built-in leveling bolts complete with sound isolation pads type B. Static deflection as specified.
- B. Type B: Sound Isolation Pad: Provide under each spring isolator a sound isolation pad, utilizing high quality durable neoprene pad material, loaded to 40 psi. Build sound pad up to 2 layers of 1/4 inch thick neoprene material; separate layers with a 16 gage galvanized sheet metal plate. Top layer shall provide a hardness of 40 durometers and the bottom layer shall be 40 durometers. Cold bond sound pads together and to isolator baseplate.
- C. Type C: Neoprene-in-Shear Isolators: Isolator shall be neoprene-in-shear type as recommended by manufacturer. Isolator shall provide a static deflection under rated load at 1/4 inch.

2.04 EQUIPMENT FRAMES

- A. Provide mounting frames and brackets to carry load of equipment without causing mechanical distortion or stress to the equipment.
- B. Type A Frame: Wide flange members, rigidized structural steel frame with brackets. Maximum allowable deflection at any point on load frame relative to unloaded frame shall be 0.005 inch. Members to be constructed of wide flange beams, with a depth of not less than 1/10 of length of span between isolators. Frame shall be M.W. Sausse & Co. type RMSB-W, as basis of design, or Mason Industries, Caldyn, or equal.
- C. Type B Frame: Channel members, rigidized structural steel frame with brackets. Frame to be constructed of channel steel with section depth equal to 1/10th length of longest structural member. Frame shall be M.W. Sausse & Co. type RMSB-C, as basis of design, or Mason Industries, Caldyn, or equal.
- D. Type C Frame: Steel gusset or bracket welded or bolted directly to machine frame in order to accommodate isolator. Frame shall be M.W. Sausse & Co. type RMSG, as basis of design, or Mason Industries, Caldyn, or equal.
- E. Type D Frame: Fabricated of rectangular channel steel forms for floating foundations to be filled with concrete on the Project site. Channel depth to be a minimum of 1/12th of longest dimension, but in no case less than 6 inches. Form shall include 1/2 inch reinforcing bars installed each way in a layer 1 1/2 inches above bottom and drilled steel members with sleeves mounted below holes to receive equipment anchor bolts. Weight

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of concrete and frame shall be two times or more than the weight of the unit it supports. Frame shall be M.W. Sausse & Co. type RMSBI, as basis of design, or Mason Industries, Caldyn, or equal.

2.05 MATERIALS AND CONSTRUCTION

A. Duct Silencers: Provide factory fabricated duct silencers of tubular or rectangular type, for low or medium velocity service, with arrangements, sizes, and capacities as indicated on the Drawings.

1. Construction:

a. Fabricate silencers of galvanized steel with casing seams sealed or welded to be airtight at a pressure differential of 8 inches water gage between inside and outside of unit, and stiffen or brace as necessary to prevent structural failure or deformation at same condition, or audible vibration during normal operation. Outer casings of rectangular silencer modules shall be made of 22 gage galvanized steel in accordance with ASHRAE Guide of recommended construction for high-pressure rectangular ductwork. Seams shall be lock formed and mastic filled. Outer casings of tubular silencers shall be made of galvanized steel in 18 to 22 gage. Internal acoustic elements of rectangular silencers shall incorporate integral die formed entry and exit to minimize pressure drop and self-noise. Interior partitions for rectangular silencers shall be fabricated of not less than 26 gage galvanized perforated steel. Interior construction of tubular silencers shall be compatible with the outside casings.

b. Filler material shall comply with the following:

- 1) Fire Safety Standards: NFPA 90A and NFPA 90B.
- 2) Temperature: ASTM C411.
- 3) Air velocity: ASTM C1071, UL 181.
- 4) Fire Hazard Classification: ASTM E84, UL 723-Class 1, NFPA 255.
- 5) Corrosion Resistance: ASTM C739, C665.
- 6) Fungi Resistance: ASTM G21.
- 7) Water Vapor Sorption: ASTM C1104, less than 1 percent by weight.
- 8) Formaldehyde, Phenolic Resins or other Volatile Organic Compounds: 0 percent.

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- c. Airtight construction shall be provided by furnishing a duct sealing compound installed on the Project site. Silencers shall not fail structurally when subjected to a differential air pressure of 8 inches w.g. inside to outside of casing.
 2. Acoustic Performance: Silencer ratings shall be determined in a duct-to-reverberant room test facility, which provides for airflow in both directions through the test silencer in accordance with ASTM Standard E477. The test facility shall be accredited by the National Voluntary Laboratory Accredited Program for the ASTM E477 test standard. Data from a non-accredited laboratory is not permitted. The test set-up and procedure shall eliminate effects due to end reflection, directivity, flanking transmission, standing waves, and test chamber sound absorption. Acoustic ratings shall include dynamic insertion loss (DIL) and self-noise (SN) power levels both for forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions). Data shall be for test silencers no smaller than the following cross-sections:

Rectangular, inches - 24 by 24, 24 by 30, or 24 by 36
Tubular, inches - 12, 24, 36, and 48

 - a. Noise reduction values (dynamic insertion loss) in decibels reference 10-12 watts, shall not be less than (of the model, size and length) indicated on Drawings.
 - b. Self generated noise in decibels reference 10 to 12 watts, shall not be more than of the model, size and length indicated on Drawings.
 3. Aerodynamic performance: Airflow measurements shall be performed in accordance with ASTM specification E477 and applicable portions of ASME, Air Movement and Control Association (AMCA), and Air Diffusion Council (ADC) airflow test codes. Tests shall be reported on the identical units for which acoustic data is presented. Air pressure drops shall not exceed those (of the model, size and length) indicated on Drawings.
 4. Certification: With submittals, provide certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance for reverse and forward flow test conditions. Test data shall be for a standard product. Rating tests shall be conducted in the same facility, shall utilize the same silencer, and shall be open to inspection if required by the Architect.
 5. Rectangular silencers shall be Industrial Acoustics Company of the model number indicated on the drawing, as basis of design, or Vibro-Acoustics, Dynasonics, SEMCO Silentair, TranSonics, Inc., or equal.
- B. Duct Liner: As indicated in Section 23 07 00: HVAC Insulation.
- C. Flexible Ducts: As indicated in Section 23 07 00: HVAC Insulation.

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PART 3 – EXECUTION

3.01 INSTALLATION

- A. Provide isolators, flexible pipe connectors, flexible electrical conduit and flexible duct connectors at all moving mechanical system components to prevent transmission of vibration noise to any part of building whether indicated on the drawings or not.
- B. Install isolators to suit imposed load and the vibration frequency to be absorbed. Isolator units shall furnish adequate strength and flexibility to exhibit proper resiliency under machine load and impact without permitting excessive movement when starting.
- C. Where commercial vibration isolator and seismic restraint units are specified, furnish manufacturer's standard catalog products with printed loading ratings, or provide substantiating calculations.
- D. Install vibration isolators and seismic restraints in accordance with manufacturer's printed installation instructions.
- E. Where equipment is belt driven and motor is not installed on equipment, install motor and driven equipment on unitized support, and install entire support isolators. Unitized support to be provided with adjustable slide rails sized for motor weight and frequency. Support shall be Mason Industries type WF, M.W. Sausse & Co., type RMSF, Caldyn, or equal.
- F. Do not install any equipment, piping, conduit, ductwork, etc., that makes rigid contact with building or its structural members, unless reviewed by the Architect.
 - 1. Coordinate Work with other trades to avoid rigid contact with building.
 - 2. Correct, before installation, any conflict with other Work that would result in solid contact to equipment or piping due to inadequate space.
 - 3. Obtain inspection from the Project Inspector for concealed Work before enclosure.
 - 4. Notify manufacturer before installation of vibration isolation devices so that manufacturer may instruct and demonstrate technique for proper installation.
- G. The furnishing or installation of vibration isolators must not cause any change of position or alignment of equipment, ductwork, or piping, resulting in stresses in piping or ductwork, connections, or misalignment of shafts or bearings. Equipment, piping, and ductwork shall be maintained in a rigid position during installation. Load shall not be transferred to isolator until installation is complete and under full operational load.
- H. Air Compressors, Water Chillers, Pumps, Boilers with Integral Combustion Fans and Miscellaneous Equipment, mounted on roof or raised floors: Install each unit with its motor on a vibration isolated base utilizing type B frames, except where a type D frame is indicated on Drawings. Install steel support frame furnished by equipment

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manufacturer, utilizing equipment anchor bolt templates and isolator height saving brackets. Provide springs as specified for type "A" isolator; static deflection shall be a minimum of 2 inches.

- I. Fans (2000 rpm or higher) Air Compressors and Miscellaneous Equipment, mounted on grade: As specified for grade mounted boilers except furnish type C isolators.

PROVIDE HOUSEKEEPING PAD DETAILS ON DRAWINGS.

- J. Boilers mounted on grade: Install each unit on concrete housekeeping pad with sound isolation pad designed for applicable equipment loading. Unit shall be fastened to housekeeping pad to prevent any movement.
- K. Air Handling, Air Conditioning Units, Floor Mounted Fans, and Cabinet-Installed Fans: Install entire casing including filters, mixing box, fan section, coil sections, etc., on a continuous, integral, structural steel base, as indicated. Furnish type A, B, or C frames, reinforced as necessary to prevent distortion of frame. Furnish isolator type A; static deflection shall be a minimum of 1 ½ inches.
- L. Suspended Fans and Air Conditioning Unit Fan Coils and Unit Ventilators: Suspend each integral unit from overhead structure on steel spring and elastomer hanger isolators. Support deflection under rated load of 3/8 inch. Provide spring static deflection as follows:

Fan RPM	Min. Deflection
200 – 400	3 inches
400 – 700	2 inches
Above 700	1 inches

- M. Pipe Isolation: Where indicated and as required, furnish and support each pipe from an isolator. Isolator for the first five support locations away from vibrating equipment shall have the same deflection as the equipment isolators. After that, isolators shall be a neoprene-in-shear type of size as recommended by manufacturer; except where indicated on Drawings, pipe hanger rod shall be furnished with a steel spring isolator and elastomeric element, with lower rod capable of 30 degrees total misalignment without contact on spring housing.
- N. Seismic Restraints: Floor or pad mounted equipment that do not require vibration isolators, shall be bolted to floor or other support. Floor mounted equipment with vibration isolators shall be provided with lateral and vertical restraining devices on all sides of base to restrict displacement of equipment. On all sides of suspended equipment, provide bracing for rigid supports and provide aircraft cable restraints for resiliently supported equipment.
- O. Ductwork, duct acoustical lining, manual volume dampers and flexible ducts: Do not reduce length of duct runs, duct acoustical lining, manual volume dampers and flexible ducts for economy.

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- P. Installation of flexible ducts at air inlets and outlets: Do not attach flexible ducts directly to air inlets and outlets unless a straight, smooth and uniform air flow can be achieved with sufficient space to make an elbow with a radius of at least three times the diameter of the duct. If sufficient space is not available to make such an elbow, provide a rigid elbow or a lined plenum.
- Q. Placement of Air Devices: Do not relocate air devices without the Architect's approval.

3.02 EXAMINATION

- A. Arrange for the services of a certified representative of isolation manufacturer to visit the Project site for inspecting installation of devices. In the event the isolators do not meet specified requirements perform necessary revisions. Submit a written report to the Architect, signed by above representative, indicating all devices are properly installed and are operating as specified or required by isolation manufacturer.

END OF SECTION

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SECTION 23 05 53 - HVAC IDENTIFICATION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Marking and identification required on mechanical piping systems, ducts, controls, valves, apparatus, etcetera.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 23 05 13: Basic HVAC Materials and Methods.
 - 3. Section 23 09 00: HVAC Instrumentation and Controls.
 - 4. Section 23 30 00: Air Distribution.
 - 5. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.

1.02 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 05 00: Common Work Results for HVAC.
- B. Submit product data and installation instructions for each item specified.
- C. Submit Samples of materials.

1.03 QUALITY ASSURANCE

- A. Comply with provisions of:
 - 1. Section 23 05 00: Common Work Results for HVAC.
 - 2. ANSI/ASME A13.1: Scheme for the Identification of Piping Systems.
 - 3. APWA: Uniform Color Code.Or
 - 4. IAPMO: Uniform Plumbing Code (UPC).

PART 2 – PRODUCTS

2.01 MATERIALS

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- A. General: Piping systems, controls, valves, apparatus, etc., except those that are installed in inaccessible locations in partitions, walls, and floors, shall be permanently identified.

2.02 VALVES

- A. Furnish prepared chart or diagram for each piping system, indicating by identifying letter or model number of each valve in the system, its location, and function.
- B. Install charts in aluminum frame with clear glass front and secure on wall where designated by the Project Inspector.
- C. Bind copies of each chart in operating instructions manual.
- D. Provide each valve with a brass, aluminum, or plastic disc, not less than 1-1/4 inches diameter bearing engraved numbers corresponding to those indicated on chart. Fasten discs to valve with No. 14 brass wire.
- E. Provide an additional tag for safety valves and other valves that could be hazardous to safety and health of occupants. Distinguish these tags from regular valve tags by color (such as yellow with black letters, and marked "Danger"); submit Sample tag to the Architect for review.

2.03 INSTRUMENTS AND CONTROLS

- A. Identify panel-mounted instruments and controls with engraved bakelite nameplates permanently affixed to panel boards.
- B. Identify alarm indicating devices and alarm reset devices by nameplates.
- C. Identify damper motors and automatic valves, flow switches, pressure switches, etc., with embossed aluminum or plastic tape affixed to controller, indicating service and setting.

2.04 EQUIPMENT

- A. Identify each major piece of equipment with engraved bakelite nameplates permanently affixed to the equipment, indicating the room numbers it services, Equipment identification designation shall be the same to its designation indicated on the "As-Built Drawings". Room numbers in the nameplates shall correspond to the final room numbers.

2.05 ABOVE GRADE PIPE IDENTIFICATION

- A. Identify pipes by means of colored labels with directional flow arrows and identification of the pipe content, in conformance to ANSI/ASME A13.1 or the UPC.
- B. Materials: Precoiled acrylic plastic with clear polyester coating, all-temperature, self-adhering, as manufactured by Brady, Brimar Industries, Seton, Stranco, Inc., or equal.

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C. Size:

Outside Diameter of Pipe or Insulation	Length of Field	Color	Size of Letter
¾ to 1 ¼-inch	8-inch		½-inch
1 ½ to 2-inch	8-inch		¾-inch
2 ½ to 6-inch	12-inch		1 ¼-inch"
8 to 10-inch	24-inch		2 ½-inch"
over 10-inch	32-inch		3 ½-inch

D. Colors: As indicated in schedule.

E. Locations:

1. On accessible piping, whether insulated or not (including mechanical rooms, attic and ceiling spaces); except that labels shall be omitted from piping where contained material is obvious due to its connection to fixtures (such as faucets, water closets, etc.).
2. Near each valve and branch connection in such accessible piping.
3. At each pipe passage through wall or floor.
4. At not more than 20 feet spacing on straight pipe run between bands required in 2 and 3 above.
5. At each change in direction.

F. Application: Install on clean surfaces free of dust, grease, oil, or any material that will prevent proper adhesion. Replace non-adhering or curling labels with new labels, as required by the Project Inspector.

G. Schedule:

Content of Pipe	Legend	Background Color	Lettering Color
Refrigeration supply	Refrigeration supply	Yellow	Black
Refrigeration return	Refrigeration return	Yellow	Black
Air conditioning condensation drain	A/C condensate drain	Green	White

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2.06 UNDERGROUND PIPE

A. Detectable Marking Tape:

1. Provide and install detectable marking tape along buried piping. Tape shall be specifically manufactured for marking and locating underground utilities with electronic equipment. Tape shall be acid and alkali resistant, and manufactured with integral wires or foil backing, encased with protective cladding. Tape shall be a minimum of two inches in width.
2. Manufacturer: Reef Industries, Inc., Advantage Brands, Inc., Northtown Company, Mutual Industries, Inc., or equal.
3. Detectable marking tape shall be color-coded per APWA Color Code:
 - a. Yellow: Steam.
 - b. Blue: Water.
 - c. Red: Electric power lines, cables, conduit and lighting cables. By Division 26.
 - d. Orange: Communication, alarm or signal cables. By Divisions 26 and 27.

B. Tracer Wire:

1. Solid copper wire type THWN, 12 AWG gage, with heat and moisture resistant insulation.

2.07 IDENTIFICATION OF AIR CONDITIONING EQUIPMENT

A. Provide identification markers to locate air conditioning equipment above T-bar ceilings. Install 3/4 inch to one inch diameter colored self-adhesive dots to T-bar ceiling grid indicating point of access. The following identification markers shall be recorded on the project record documents:

1. Fire Damper and Combination Fire/Smoke Fire Damper: Red.
2. Manual Volume Dampers, Relief Dampers, Motorized Volume Dampers: Blue.
 - a. Supply air: Full dot.
 - b. Return air: Half dot.
3. Fan coil unit: Green.
4. Filter Location if separate from fan coil: Yellow.

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PART 3 – EXECUTION

3.01 INSTALLATION

- A. Correct detrimental conditions prior to commencing the Work of this Section. Install markers and identification tags as specified with materials and installation procedures recommended by manufacturer.
- B. Place tracer wire on top of non-metal utility lines allowing some slack. Do not wrap tracer wire around pipe. Fasten tracer wire in place at approximately 10 feet on centers with non-metal ties.
- C. Install underground detectable pipe marking tape continuously buried 8 to 10 inches above the buried utility pipe. Wrap tape on pipe risers up to a height of 12 inches above grade.

3.02 CLEANUP

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

END OF SECTION

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SECTION 23 07 00 - HVAC INSULATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Condensate drain piping from air conditioning equipment.
2. Refrigerant piping.
3. Supply and return air ducts for heating and cooling systems air ducts.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 23 05 00: Common Work Results for HVAC.
3. Section 23 05 13: Basic HVAC Materials and Methods.
4. Section 23 05 53: Mechanical Identification.
5. Section 23 30 00: Air Distribution.
6. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.

1.02 REFERENCES

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

1. ASTM C167 - Standard Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations.
2. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board.
3. ASTM C302 - Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation.
4. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
5. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
6. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

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7. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 8. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
 9. ASTM D5116 - Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.
 10. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 11. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
 12. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 13. ASTM G22 - Standard Practice for Determining Resistance of Plastics to Bacteria.
- B. Underwriters Laboratories Inc.:
1. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.
 2. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.
- C. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems .
 2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 3. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

- A. Submit in accordance with Division 01 and Section 23 05 00: Common Work Results for HVAC.
1. Complete material list of items to be furnished and installed under this Section.
 2. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements.

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3. Shop Drawings, catalog cuts and manufacturer's data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by manufacturer to comply with the California quality standards for insulating materials.
4. Display sample cutaway sections.
5. Manufacturer's recommended method of installation procedures, which will become part of this Section.

1.04 QUALITY ASSURANCE

- A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 23 05 00: Common Work Results for HVAC and Section 23 05 13: Basic HVAC Materials and Methods.
- B. Test Ratings:
 1. Comply with provisions stated under Section 23 05 00 and 23 05 13 with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.
 2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.
 3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.
 4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.
- C. Regulatory Requirements: Insulation furnished and installed under this Section shall conform to the requirements of the California Building Code Parts 4, Mechanical Code, Part 5, Plumbing Code and Part 6, Energy Code.
- D. All chemically based products such as sealers, primers, fillers, adhesives, etc. shall meet the California air quality regulations.

1.05 PRODUCT HANDLING

- A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 23 05 00: Common Work Results for HVAC and 23 05 13: Basic HVAC Materials and Methods.

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PART 2 – PRODUCTS

2.01 MATERIALS

A. General:

1. Piping insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.
2. Piping insulating material shall be furnished with thickness indicated in Table 1, unless otherwise noted on the drawings, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75 degrees F. For any other value of R, insulation thickness shall be calculated accordingly and submitted for review.
3. Asbestos in any quantity in insulating material is not permitted.
4. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:
 - a. Nylon anchors for installing insulation to ducts or equipment.
 - b. Treated wood blocks.
5. Flame-proofing treatments subject to moisture damage are not permitted.

TABLE 1 - MINIMUM PIPING INSULATION THICKNESS (1)

Insulation Thickness Required (in inches)
Space Heating Systems (Steam, Steam Condensate and Hot Water)

Piping Type	System	Temp. Range (degrees F)	Run-outs up to 2 (2)	1 and less	1.25 to 2	2.5 to 4
Refrigerant		Below 40	1.0	1.0	1.5	1.5
Condensate Drain		½-inch Minimum insulation thickness.	0.5	0.5	0.5	0.5
From Conditioning Equipment:	Air	Insulate condensate drain lines within building, in room, inside walls and above ceilings.	0.5	0.5	0.5	0.5

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NOTES:

- (1) For piping exposed to ambient temperatures, increase thickness by 0.5 inch.
 - (2) Run-outs to individual terminal units, not exceeding 12 feet in length.
- B. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance to manufacturer's recommendation. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by manufacturer.
- C. Canvas Jackets: Furnish 6 ounce in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.
- D. Insulation Jackets:
1. Exterior insulation exposed to weather shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16-inch corrugations. Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.
 2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of ½-inch to 8-inch shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or equal, manufactured from 1100 aluminum alloy of 0.024-inch thickness. Insulated elbows with a nominal pipe size of 10 inches to 18 inches shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or equal.
 3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation Covers as manufactured by Childers Products Company, Pabco, RPR, or equal.
- E. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.
- F. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knauf Insulation, Speedline, or equal.

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2.02 PIPING SYSTEM INSULATION

A. General: Insulate chilled water supply and return piping and refrigerant piping.

B. Materials:

1. Classes of Insulation:

- a. Class A: Expanded polystyrene pipe insulation, self-extinguishing type, either molded or extruded; Dow Chemical Co. STYROFOAM, ITW Insulation Systems XPS PIB, Foam-Control EPS, or equal.
- b. Class B: Glass fiber molded pipe insulation ASTM C547. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire-retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, CertainTeed Snap-On, Owens Corning FIBERGLAS SSL II-ASJ, or equal.
- c. Class C: Expanded (foamed) urethane (polyurethane) or polyisocyanurate pipe insulation of self-extinguishing type molded or fabricated, Dyplast Products, LLC ISO-C1/2.0, ITW Trymer, Specialty Products & Insulation Co. Polyisocyanurate Pipe Insulation, Armacell Armalok, or equal.
- d. Class D: Foamed plastic pipe insulation, self-extinguishing type, ASTM C534 Type 1 - tubular. Pipe insulation shall be one-piece preformed, flexible tubing type and provide a maximum K factor of 0.28 at 75 degrees F mean temperature. Pipe insulation shall be Armacell Armaflex, Aeroflex Aerocel, Rubatex INSUL-TUBE 180, or equal.

2. Locations and Class of Insulation Required: For thickness required, refer to Table 1 of this Section.

TABLE 3 – SERVICE, LOCATION AND CLASS OF INSULATION REQUIRED

<u>SERVICE</u>	<u>LOCATION</u>	<u>CLASS OF INSULATION</u>
Condensate drains from air conditioning equipment	Indoors at all locations including above ceilings and between stud walls	D
Refrigerant suction Liquid line as required	All locations except underground	D
All other piping, except underground	All locations except underground	A, B, C

3. Adhesives:

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- a. Polystyrene adhesives: Synthetic rubber and resin adhesives specifically designed to adhere extruded and expanded rigid polystyrene and urethane insulation to themselves and to other porous and non-porous substrates.
- b. Vapor barrier laps and penetrations: Furnish protective coating and lagging adhesive on butt joints of foil-faced vapor barriers, and where pins and staples puncture facings.

2.03 DUCTWORK AND PLENUM INSULATION

A. General: Insulate ductwork and plenums with not less than the amount of insulation tabulated in Table 4, unless noted otherwise on the drawings. Insulation may be omitted under the following conditions:

- 1. Exposed return air ductwork in conditioned space.
- 2. Return air ductwork between wall studs inside an interior wall.

TABLE 4 - INSULATION OF DUCTS AND PLENUM

<u>Duct Location</u>	<u>Insulation Type</u>
Exposed interior round and oval supply air ductwork located at Gyms and MPR Stages	DW-1
Exposed interior rectangular supply air ductwork located at Gyms and MPR Stages	L-1
Exterior locations of Health Units and Clinics	DW-2
Exterior locations other than Health Units and Clinics	L-2
In walls, within floor/ ceiling spaces	F-1 or L-1 See note 3
Hot and cold plenums	F-2, DW-1 or L-2 See note 3
Attics, Garages, and Crawl Spaces, within unconditioned space or in basement	F-3 or L-2 See note 3

B. Insulation Types:

- 1. DW-1: 1-inch thick insulation sandwiched inside double-wall type ducts and fittings.
- 2. DW-2: 2-inch thick insulation sandwiched inside double-wall type ducts and fittings. Duct joints shall be waterproofed.
- 3. F-1: 1½-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.

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4. F-2: 2-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
5. F-3: 3-inch blanket fiberglass, factory-laminated with all-service jacket vapor barrier.
6. L-1: 1½-inch Internal duct lining.
7. L-2: 2-inch Internal duct lining.

C. Notes:

1. Minimum insulation provided shall be as required by the current California Mechanical Code Title 24 for the most restrictive condition.
2. Refer to the materials indicated in this section for external insulation & Internal Lining.
3. External insulation shall be replaced with internal duct lining (of equivalent thermal resistance value unless noted otherwise) where indicated on the drawings or specified elsewhere for sound attenuation.
4. Provide internal duct lining (1 ½-inch unless noted otherwise) where indicated on the drawings or specified elsewhere for sound attenuation.
5. All exterior insulated ductworks shall be water proofed at joints, seams and duct penetrations.

D. Materials:

1. Fire-Resistive Insulation Materials and Coatings: Submit State Fire Marshal pre-approved materials only.
2. Adhesives: See Paragraph 2.01.E for applicable products.
3. External Insulation: Provide glass fiber blankets that are factory-laminated with Foil Reinforced Kraft (FRK) vapor barrier facing; Johns Manville Microlite, Owens-Corning SOFTR Duct Wrap, Knauf Insulation Friendly Feel Duct Wrap, or equal. Provide a minimum installed R value as required by the CEC Building Energy Efficiency Standards; but not less than scheduled on Table 5:

TABLE 5
INSULATION OF DUCTS AND PLENUM INSTALLED
THERMAL RESISTANCE "R" VALUES

Type	Labeled Thickness (in inches)	Installed R Value (hr.ft ² .°F/Btu)
F-1	1 ½	4.2

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F-2	2	5.6
F-3	3	8.3
DW-1	1	4.2
DW-2	2	5.6
L1	1 ½	6.0
L2	2	8.0

4. Internal Lining: Internal Lining shall be of the type that inhibits the growth of mold, mildew and fungi and shall not contain harmful VOC's or contain glass fiber. Approved Material:
- a. Polyester Duct Liner:
 - 1) Polyester duct liner shall be an engineered nonwoven, thermally bonded Polyester with a smooth and durable FSK facing.
 - 2) Polyester duct liner must be able to withstand a constant internal temperature up to 250°F must be compliant with Greenguard Environmental Institute and contain zero VOCs per ASTM D5116. Liner must comply with all applicable standards including ASTM E84, ASTM C411, ASTM C518, ASTM G21, NFPA 90A and 90B, and UL 181.
 - 3) Approved Manufacturer: Ductmate Industries "PolyArmor" duct liner or approved equal.
 - b. Elastomeric duct liner:
 - 1) Closed-cell, sponge- or expanded-rubber materials. Elastomeric liner must be able to withstand a constant internal temperature up to 300°F and must comply with all applicable standards including ASTM E84, ASTM E96, ASTM C209, ASTM C534 - Type II sheet materials, ASTM C411, ASTM C518, ASTM G21, ASTM G22, NFPA 90A and 90B, and UL 181.
 - 2) Approved Manufacturer: Armacell LLC "AP Armaflex FS" duct liner or approved equal.
 - c. Duct liner must be attached per manufacturer's requirements using a non-flammable, low VOC water-based adhesive. When applicable, apply a non-flammable, low VOC water-based lagging adhesive to the exposed leading edge of the insulation. Install fasteners per SMACNA HVAC Duct Liner installation instructions.

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- d. Duct liner must be installed per SMACNA Manual, "HVAC Duct Construction Standards, Metal and Flexible," Third Edition unless otherwise specified.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.
- B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers, supports, anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.
- D. Pipe or duct insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where fire-stop or fire-safing materials are required.
- E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.
- F. Insulation shall not be installed in the following locations unless otherwise noted:
 - 1. On vacuum return lines less than 50 feet long.
 - 2. On unions, flanged connections or valve handles.
 - 3. Over edges of any manhole, clean-out hole, clean-out plug, access door or opening to a fire damper, so as to restrict opening or identification of access.
 - 4. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.02 INSTALLATION OF PIPING SYSTEM INSULATION

- A. General: Chilled water supply and return piping, refrigerant piping and condensate drain lines, after having been tested, shall be cleaned and insulated.
- B. Application: Insulation on chilled water lines, refrigerant suction lines and liquid lines, if indicated, and air conditioner interior drain lines shall be jacketed with fire-

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resistant vapor barrier of laminated aluminum foil consisting of 2 plies with glass-yarn reinforcing. Jacket joints shall be lapped and sealed with an approved adhesive. Insulation shall be secured with aluminum bands not less than 0.005-inch thick by ¾-inches wide, spaced not over 12-inch on centers, or as recommended by manufacturer.

1. Longitudinal Seams: Butt hinged sections of covering tightly together and seal down jacket flap with adhesive, or with factory-applied, self-sealing lap with pressure-sensitive sealer protected with release paper.
2. End Joints: Wrap joint with a 3-inch wide (minimum) self-sealing tape.
3. Fittings and Valves: Fittings and valves shall be covered with same material of same thickness as pipe insulation, sealed with an approved, vapor-sealing tape or compound and covered with Johns Manville Zeston polyvinyl-chloride cover, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.
4. Pipe hangers shall be insulated or attached to pipe by an insulating insert, butted between adjoining insulation sections.

C. Additional Jackets:

1. Exposed Indoor Insulation: Cover with 26 gage galvanized sheet metal jacket to 8 feet above floors, except in mechanical equipment rooms and accessible pipe tunnels.
2. Exposed Outdoor Insulation: In addition to canvas or fiberglass cloth cover, provide 0.016-inch thick aluminum jacket with 1-inch wide aluminum bands and seals. Install appropriate jackets on valves and fittings.

3.03 INSTALLATION OF DUCTWORK AND PLENUM INSULATION

A. External Covering:

1. Before installing duct insulation, sheet metal ducts shall be clean, dry, and tightly sealed at joints and seams, inspected pressure tested, and accepted by OAR/ Inspector.
2. Duct exterior insulation shall be firmly wrapped around ductwork with joints lapped a minimum of 2-inch. Insulation shall be securely fastened with 18 gage copper-lined steel wire, or 16 gage soft-annealed galvanized wire spaced approximately 12-inch on centers and at loose ends, presenting a neat and workmanlike appearance. Where duct width is such that wiring will not fasten insulation firmly against duct an adhesive shall be furnished to fasten insulation to duct with wiring being installed at ends of insulation segment.

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3. Insulation on ductwork transporting conditioned air, both supply and return, and outside air intake ducts when pre-conditioned, shall be furnished with a factory-applied, fire-resistant vapor barrier.
4. Exposed Ducts or Plenum:
 - a. Install insulation to ducts or plenum furnished with butt joints, without voids and with adhesive over entire surface of duct. Cover insulation with canvas jacket, fastened tightly to insulation with lagging adhesive. Install 2 finish coats of undiluted adhesive.
 - b. When installing jacket, finished covering shall be even and level, without humps, with constant diameters on round ducts maintained.

B. Interior insulation - lining:

1. Dimensions of ducts indicated are net inside dimensions and must include thickness of duct liners to obtain the required duct size.
2. Install insulation in square turns, where required, to cover interior surfaces before duct turns are installed.
3. Install lining material during fabrication of duct with sealed face only exposed to air stream.
4. Interior insulation in ducts or plenums shall not have exposed edges. Edges open to entering or leaving air streams shall be covered, secured in place and sealed with approved duct liner edge sealers.
5. Insulation shall be fastened to sheet metal with an approved fire-retardant adhesive, with minimum 90 percent coverage and edges firmly adhered.
6. Mechanical fasteners shall supplement the adhesive on top sections of ducts more than 12-inch wide and on sides of ducts more than 24-inch high and shall be spaced on 16-inch centers maximum. Fastener posts shall be cut off approximately 1/4-inch from metal disc.

3.04 CLEANUP

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

3.05 PROTECTION

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

END OF SECTION

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SECTION 23 08 00 - HVAC SYSTEMS COMMISSIONING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for Commissioning (Cx) of HVAC systems and equipment including installation, start-up, testing, documentation, and training according to the Construction Documents.
2. Standard procedures for the execution of commissioning work shall be in conformance with Division 01, Section 01 91 13: General Commissioning Requirements. Coordinate work with the Commissioning Services Provider (CxSP).

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 01 45 23: Testing and Inspection.
3. Section 01 45 25: Testing, Adjusting, and Balancing for HVAC.
4. Section 01 79 00: Maintenance and Operations Staff Demonstration and Training.
5. Section 01 91 13: General Commissioning Requirements.
6. Section 23 05 00: Common Work Results for HVAC.
7. Section 23 30 00: Air Distribution.
8. Section 23 38 13: Kitchen Ventilation System.
9. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.
10. Section 26 05 00: Common Work Results for Electrical.
11. Section 26 05 13: Basic Electrical Materials and Methods.
12. Section 26 05 19: Low Voltage Wires (600 Volt AC).
13. Section 26 05 26: Grounding and Bonding.
14. Section 28 31 49: Carbon Monoxide Detection and Alarm Systems.
15. Section 26 05 86: Motors and Drives.
16. Section 26 08 00: Electrical Systems Commissioning.
17. Section 26 29 13: Adjustable Frequency Drives.
18. Project Commissioning Plan (CxP).

1.02 REFERENCES

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- A. Applicable codes, standards, and references: inspections and tests shall be in accordance with the following applicable codes and standards:
1. InterNational Electrical Testing Association – NETA.
 2. National Electrical Manufacturers Association – NEMA.
 3. American Society for Testing and Materials – ASTM.
 4. Institute of Electrical and Electronics Engineers – IEEE.
 5. American National Standards Institute – ANSI.
 6. National Electrical Safety Code – NESC.
 7. California Building Code – CBC.
 8. California Electrical Code – CEC.
 9. California Mechanical Code – CMC.
 10. Insulated Cables Engineers Association – ICEA.
 11. Occupational Safety and Health Administration – OSHA.
 12. National Institute of Standards and Technology – NIST.
 13. National Fire Protection Association – NFPA.
 14. American Society of Heating and Air-Conditioning Engineers – ASHRAE
(The HVAC Commissioning Process, ASHRAE Guideline).
 15. Associated Air Balance Council – AABC (National Standards for Total System Balance).

1.03 SUBMITTALS

- A. Submittals package shall include the following:
1. Commissioning required submittals in accordance with Division 01 Specification Sections.
 2. Copy of the Architect's reviewed and accepted submittals to the CxSP via the OAR.
 3. List of team members who will represent the Contractor in the Pre-functional Equipment Checks (PEC) and Functional Performance Tests (FPT), at least six weeks prior to the start of Pre-functional Equipment Checks.
 4. Detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, a copy of full details of Owner-contracted tests, full factory testing reports, if any, and Warranty information, including responsibilities of Owner to keep Warranty in force clearly defined.
 5. Installation and checklist documentation shipped with equipment and field checklist forms to be used by factory or field technicians.

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6. Detailed manufacturer's recommended procedures and schedules for PECs, supplemented by Contractor's specific procedures, and FPTs, at least four weeks prior to the start of PEC.

1.04 MEETINGS, SEQUENCING AND SCHEDULING

- A. Meetings: Attend the Cx meetings as required under Section 01 91 13 and Cx Plan.
- B. Sequencing and Scheduling: The work described in this Section shall begin only after work required in related Divisions 23 and 26 Sections has been successfully completed and tests, inspection reports, and Operation and Maintenance manuals required have been submitted and accepted. The start-up and PEC shall be completed and submitted to the Owner at least two weeks prior to beginning FPT.
 1. Coordinate HVAC work with the work of other trades prior to scheduling of any Cx procedures.
 2. Coordinate the completion of HVAC testing, inspection, and calibration prior to start of Cx activities.

1.05 QUALITY CONTROL

- A. Comply with Division 01 quality control specifications.
- B. Incorporate manufacturer's recommended Cx procedures for the systems and equipment to be commissioned under this Section.
- C. Comply with Section 01 45 25: Testing, Adjusting, and Balancing for HVAC.

1.06 EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

- A. Split Systems.
- B. Make Up Air Units, with gas fired heat and evaporative cooling.
- C. Fan Coil Units.
- D. Variable Volume and Temperature System.
- E. Exhaust Fans.
- F. Ventilators.
- G. Water Heaters, Gas and Electric.
- H. Air Conditioning Units.

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

- A. Equipment to be utilized in the commissioning process shall meet the following requirements:

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1. Provide test equipment as necessary for the testing of the equipment and systems to be commissioned.
2. Provide testing equipment and accessories that are free of defects and certified for use.
3. Provide testing equipment with current calibration labels as per NIST Standards.
4. Equipment shall be calibrated on the manufacturer's recommended intervals with calibration tags affixed to the instrument. In the absence of calibration tags, calibration documentation shall be submitted to the CxSP at least thirty days prior to use; this documentation shall include description and serial number of instrument and calibration data and date.
5. Testing equipment shall be maintained in good operating condition for the duration of the project.

PART 3 – EXECUTION

3.01 COMMISSIONING PROCESS REQUIREMENTS

- A. Work to be performed prior to commissioning:
 1. Complete phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.
 2. If modifications or corrections to the installed system(s) are required to bring the system(s) to acceptance levels due to Contractor's incorrect installation or defective materials, such modifications shall be made at no additional cost to the Owner.
 3. Normal start-up services required to bring each system into full operational state:
 - a. Testing, motor rotation check, control sequences of operation, full and part load performance.
 - b. Commissioning shall not start until each system is complete and start-up has been performed.
- B. Pre-Commissioning responsibilities:
 1. Inspection, calibration and testing of the equipment required to commission the following systems:
 - a. HVAC System(s).
- C. Commissioning Process Requirements:
 1. Refer to Section 01 91 13: General Commissioning Requirements and related Sections for information on meetings, start-up plans, Pre-Functional and FPT, operations and maintenance data, training requirements, and other Cx activities.

3.02 PREPARATION

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- A. Provide certified HVAC technicians as required, with tools and equipment necessary to perform Cx activities specified.
- B. Provide certified testing agency personnel and equipment factory representatives as require in the Cx plan and other related Sections.
- C. Verify that work required in this Section and in Section 01 91 13 is complete prior to starting of FPT.
- D. Verify that complete operational manuals have been reviewed and accepted by the CxSP as specified before starting FPT.

3.03 TESTING

- A. Testing procedures shall include the following minimum information:
 - 1. Test number.
 - 2. Equipment used for the test, with manufacturer and model number and date of last calibration.
 - 3. Date and time of the test.
 - 4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
 - 5. Identification of the system, subsystem, assembly, or equipment.
 - 6. Conditions under which the test was conducted, including (as applicable); ambient conditions, set points, override conditions, status, and operating conditions that impact the results of the test.
 - 7. Systems and assemblies test results and performance and compliance with contract requirements.
 - 8. Issue number, if any, generated as the result of the test.
 - 9. Name(s) and signature(s) of witnesses and the person(s) performing the test.
- B. Contractor shall participate and perform Cx related testing requirements as specified.
- C. General Requirements for Mechanical, Controls, and Testing and Balance:
 - 1. Construction and Acceptance Phases:
 - a. Provide assistance to CxSP in preparing FPT procedures specified. Sample test forms are included in the project Cx Plan.
 - b. Develop full startup and initial checkout plan using manufacturer's start-up procedures and Cx checklists for commissioned equipment. Submit to CxSP for review and approval prior to startup.
 - c. During startup and initial checkout process, execute mechanical-related portions of PEC for the equipment and systems to be commissioned.

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- d. Perform and clearly document completed startup and system operational checkout procedure. Providing four copies of the results to the Owner.
- e. Resolve any open punch list items before FPT. Air testing and balance shall be completed with discrepancies and problems remedied before FPT of respective air -related systems.
- f. Provide skilled technicians to execute starting of equipment and to execute PFT. Ensure that technicians are available and present during agreed upon schedules and for sufficient duration to complete necessary tests, adjustments, and solutions to identified problems.
- g. Maintain a log of events and issues of tests and related Cx activities. Submit handwritten reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests, and lists of completed tests as specified.
- h. Correct open issues and re-test as needed to prove compliance with system operational standards.
- i. Prepare Operation and Maintenance Manuals and provide training for the Owner maintenance personnel and end-users per Section 01 79 00.
- j. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of Warranty and notify the Owner.
- k. Execute simulated seasonal FPT, witnessed by the Owner and the CxSP, as specified. Document results and perform corrections as needed for system acceptance and make necessary adjustments to Maintenance and Operations Manuals and Record Drawings.

3.04 SENSOR CALIBRATION

- A. Field-installed temperature, relative humidity, CO₂, pressure sensors, pressure gages, and actuators (dampers and valves) shall be calibrated using the methods described below. Calibration procedures shall be documented during execution of the Start-up and the PEC. Alternate methods may be used, if approved by the CxSP.
- B. Test instruments shall have had a NIST certified calibration within the last 12 months. Sensors installed in the unit at the factory with provided calibration certification need not be field calibrated.
- C. Sensors:
 - 1. Verify that sensor locations are appropriate and away from causes of erratic operation.
 - 2. Verify that sensors with shielded cable are grounded only at one end.

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3. For sensor pairs that determine a temperature difference, make sure they are reading within 0.2 degrees F of each other.
4. For sensor pairs that determine a pressure difference, make sure they are reading within 2 percent of each other.
5. Calibration: Put the equipment in operation. Make a reading with a calibrated test instrument within six inches of the site sensor. Verify that the sensor reading (via the permanent thermostat or gage) is within the tolerance listed in the table below of the instrument-measured value. If not, calibrate or replace sensor.
6. Tolerances:

<u>Sensor</u>	<u>Required Tolerance (+/-)</u>
AHU wet bulb or dew point	2.0 degrees F
Outside air, space air, duct air temps	0.4 degrees F
Watt-hour, voltage, and amperage	1 percent of design
Pressures, air, water and gas	3 percent of sensor range (inc. design value)
Flow rates, air	10 percent of sensor range (inc. design value)
Flow rates, natural gas	5 percent of sensor range (inc. design value)
Relative humidity	4 percent
CO ₂ monitor	100 ppm
Sound level	5 db - Type 1 meter (Per Calibrator Mfg.)
Domestic Hot Water Temperature	1.5 degrees F
Domestic Hot Water Pressures Water and Gas	3 percent of sensor range (inc. design value)

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Flow Rates, Domestic Water 4 percent of sensor range (inc. design value)

Flow Rates 5 percent of sensor range (inc. design value)

3.05 ADJUSTING

- A. Perform work required to rectify installations not meeting contract requirements at no additional cost to the Owner.
- B. Corrective work shall be completed in a timely manner to permit completion of the Cx process.
- C. If systems' Cx deadline, as defined in the Project Schedule, goes beyond the scheduled completion without resolution of the problem(s), the Owner reserves the right to obtain supplementary services or equipment to resolve the problem.

3.06 TRAINING

- A. Provide training plan for systems to be commissioned as required in applicable Division 23 specification sections and Section 01 79 00.

END OF SECTION

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SECTION 23 08 13 - ENVIRONMENTAL CONTROLS AND ENERGY MANAGEMENT
SYSTEMS COMMISSIONING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for the Commissioning (Cx) of the Environmental Controls and Energy Management System (ECEMS), and interfacing with other systems such as, lighting controls and HVAC systems interconnection, including installation, start-up, testing and documentation according to Construction Documents and Commissioning Plan (CxP).
2. Standard procedures for the execution of commissioning work shall be in conformance with Division 01, Section 01 91 13: General Commissioning Requirements. Coordinate work with the Commissioning Services Provider (CxSP).

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 01 45 23: Testing and Inspection.
3. Section 01 77 00: Contract Closeout.
4. Section 01 79 00: Maintenance and Operations Staff Demonstration and Training.
5. Section 01 91 13: General Commissioning Requirements.
6. Section 23 05 00: Common Work Results for HVAC.
7. Section 23 05 13: Basic HVAC Materials and Methods.
8. Section 23 08 00: HVAC Systems Commissioning.
9. Section 23 09 00: Instrumentation and Controls.
10. Section 23 09 23: Environmental Controls and Energy Management Systems.
11. Section 23 30 00: Air Distribution.
12. Section 23 38 18: Kitchen Ventilation System.
13. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.
14. Section 26 05 00: Common Work Results for Electrical.
15. Section 26 05 13: Basic Electrical Materials and Methods.
16. Section 26 05 19: Low Voltage Wires (600 Volt AC).
17. Section 26 05 26: Grounding and Bonding.
18. Section 26 05 86: Motors and Drives.

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19. Section 26 08 00: Electrical Systems Commissioning.
20. Section 26 24 19: Motor Control Centers and Motor Control Devices.
21. Section 26 29 13: Adjustable Frequency Drives.
22. Project Commissioning Plan.

1.02 REFERENCES

- A. The latest version of applicable codes, standards, and references: Inspections and tests shall be in accordance with the following applicable codes and standards, except as provided otherwise herein:
1. National Electrical Manufacturers Association – NEMA.
 2. American Society for Testing and Materials – ASTM.
 3. American National Standards Institute – ANSI.
 4. California Electrical Code – CEC.
 5. Occupational Safety and Health Administration – OSHA.
 6. National Institute of Standards and Technology – NIST.
 7. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). – Building Management and Energy Management Systems Commissioning, ASHRAE Guideline.
 8. California Building Code – CBC.
 9. California Mechanical Code – CMC.
 10. InterNational Electrical Testing Association (NETA) Acceptance Testing.

1.03 SUBMITTALS

- A. Submittals shall include the following:
1. Required Cx submittals in accordance with Division 01 Specifications.
 2. Copy of the Architect's reviewed and accepted submittals to the CxSP via the OAR.
 3. List of team members who will represent the CONTRACTOR in the Pre-functional and Functional Performance Testing, at least two weeks prior to the start of Pre-functional Equipment Checks.
 4. Detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, checklist documentation and field checklist forms to be used by factory or field technicians, and a copy of full details of OWNER-contracted tests, full factory testing reports, if any, and Warranty information, including responsibilities of OWNER to keep Warranty in force, clearly defined.
 5. Detailed manufacturer's recommended procedures and schedules for Pre-functional Equipment Checks, supplemented by CONTRACTOR's

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specific procedures, and Functional Performance Tests, at least four weeks prior to the start of Pre-functional Performance Tests.

6. System logic documentation and sequence of operations for review and approval.
7. Provide Level 1 passwords.
8. After facility's commission is complete, submit completed Pre-functional Equipment Checklists and Functional Performance Test checklists organized by system and by subsystem. Bind information in a single package. The results of failed tests shall be included along with a description of the corrective actions taken.

1.04 MEETINGS, SEQUENCING AND SCHEDULING

- A. Meetings: Attend Cx meetings as required under Section 01 91 13, any other related Sections and the CxP.
- B. Sequencing and Scheduling: The work described in this Section shall begin only after work required in related Division 23 and 26 Sections have been successfully completed, and tests, inspection reports and Operation & Maintenance manuals required have been submitted and reviewed. The start-up and Pre-functional Equipment Checklists shall be completed and submitted to the OWNER's Authorized Representative (OAR) prior to the Functional Performance Tests.
 1. Coordinate electrical work with the work of other trades prior to scheduling of any Cx procedures.
 2. Coordinate the completion of electrical testing, inspection, and calibration prior to start of Cx activities.
 3. Cx activities shall be scheduled in accordance with project's Section 01 91 13 and Cx plan.

1.05 QUALITY CONTROL

- A. Comply with OWNER's Quality Control Specifications.
- B. Incorporate manufacturer's recommended Cx procedures for the systems and equipment to be commissioned under this Section.
- C. Typical quality control procedures include but are not limited to the following:
 1. Attend CxSP progress and coordination meetings.
 2. Establish trend logs of system schedules as required in Section 23 09 23.
 3. Demonstrate system operation and compliance with contract documents.
 4. Manipulate systems and equipment to facilitate testing.
 5. Provide instrumentation necessary for verification and performance testing.
- D. Provide ECEMS technician(s) to work at the direction of the CxSP for software optimization assistance for a minimum of 8 hours. Refer to Part 3 for a description of the software optimization.

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- E. Compensation for Retesting: Compensate OWNER for site time necessitated by incompleteness of systems or equipment at time of Functional Performance Testing (FPT). Testing failures, which require on-site time for retesting, will be considered actual damages to the OWNER. Parties under contract with the OWNER who are affected by the retesting shall be included in the contract modification.
- F. Allow sufficient time before final commissioning dates to complete electrical testing, inspection, and calibration to avoid delays in the commissioning process.
- G. During the commissioning activities, provide labor and materials to make corrections when required, without undue delay.

1.06 COORDINATION

- A. Coordinate the completion of electrical testing, inspection, programming and calibration prior to start of commissioning activities.
- B. Coordinate factory field-testing per the requirements of this Section.
- C. Coordinate commissioning efforts with CxSP prior to commencing any activities.

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

- A. Equipment to be used in the commissioning process shall meet the following requirements.
 - 1. Provide test equipment as necessary for start-up and commissioning of the EMS system.
 - 2. Provide testing equipment and accessories that are free of defects and are certified for use.
 - 3. Provide testing equipment with current calibration labels as per NIST Standards; Equipment shall be calibrated on the manufacturer's recommended intervals with calibration tags affixed to the instrument. In the absence of calibration tags, calibration documentation shall be submitted to the CxSP at least thirty days prior to use; this documentation shall include description and serial number of instrument and calibration date and time.
 - 4. Testing equipment shall be maintained in good operating condition for the duration of the project.
 - 5. Testing equipment shall be UL Listed.
- B. Instrumentation required to verify readings and test the system and equipment performance shall be provided by the CONTRACTOR and made available to CxSP. Generally, no testing equipment will be required beyond that required to perform CONTRACTOR's work under contract documents.

2.02 TESTING AND AIR BALANCING AND COMMISSIONING

- A. Provide a portable operator's terminal or hand-held device to facilitate testing, adjusting, and calibration of controls. This device shall support functions and

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allow querying and editing of parameters required for proper calibration and start up.

- B. Connections shall be provided local to the device being calibrated. For instance, for VAV boxes, connection of the operator's terminal shall be either at the sensor or at the terminal box. Otherwise, a wireless system shall be provided to facilitate this local functionality.

PART 3 – EXECUTION

3.01 COMMISSIONING PROCESS REQUIREMENTS

- A. Work prior to commissioning:
 - 1. Complete phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.
 - 2. If contractual modifications are required to bring the system(s) to acceptance levels, such modifications shall be made at no additional cost to the OWNER.
 - 3. Normal start-up services required to bring each system into full operational state:
 - a. Testing, motor rotation check, control sequences of operation, full and part load performance.
 - b. Commissioning will not start until each system is complete and start-up has been performed.
- B. Pre-Commissioning responsibilities:
 - 1. Inspection, calibration and testing of the equipment required to commission the following systems:
 - a. Environmental Controls and Energy Management Systems.
 - b. Interface and connections of EMS system with lighting controls, electric utility meter, gas meter, photo voltaic system, or as otherwise indicated in contract documents.
- C. Commissioning Process Requirements:
 - 1. Refer to Section 01 91 13: General Commissioning Requirements and related Sections for information on meetings, start-up plans, Functional Performance Testing (FPT), operations and maintenance data, training requirements, and other Commissioning activities.

3.02 PREPARATION

- A. Provide certified EMS technicians as required, with tools and equipment necessary to perform Cx activities specified.
- B. Provide certified testing agency personnel and equipment factory representatives as required in the Cx plan and other related Sections.

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- C. Verify that work required in this Section and in Section 01 91 13 is complete prior to starting of FPT.
- D. Verify that complete operational manuals have been reviewed and accepted by the CxSP as specified before starting FPT.

3.03 START-UP, TESTING, ADJUSTING, AND CALIBRATION

- A. Work or systems installed shall be fully functioning prior to Demonstration and Acceptance Phase. Start, test, adjust, and calibrate work as described below:
 - 1. Inspect the installation of devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.
 - 2. Verify proper electrical voltages and amperages and verify that circuits are free from faults.
 - 3. Verify integrity/safety of electrical connections.
 - 4. For AHUs that use a throttled outside air damper position when minimum outside air is required, mark the minimum outside air damper position.
 - 5. Coordinate with testing and air balance (TAB) subCONTRACTOR to obtain, Cx and fine-tune control settings that are determined from balancing procedures. Record the following control settings as obtained from TAB CONTRACTOR, and note any TAB deficiencies in the ECEMS Start-up report:
 - a. Optimum duct static pressure setpoints for VAV air handling units.
 - b. Minimum outside air damper settings for air handling units.
 - c. Optimum differential pressure setpoints for variable speed pumping systems.
 - d. Calibration parameters for flow control devices such as VAV boxes and flow measuring stations.
 - 6. Test, calibrate, and set digital and analog sensing and actuating devices. Test equipment shall be 50 percent more accurate than the field device over the same range. Calibrate each instrumentation device by making a comparison between the ECEMS display and the reading at the device. (e.g., if field device is plus or minus 0.5 percent accurate, test equipment shall be plus or minus 0.25 percent accurate over the same range). Record the measured value and displayed value for each device in the ECEMS start-up report.
 - 7. Check and set zero and span adjustments for transducers and transmitters.
 - 8. Dampers and Valves:
 - a. Check for adequate installation including free travel throughout range and adequate seal.

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- b. Where loops are sequenced, check for proper control with overlap.
9. Actuators:
 - a. Check to ensure that device seals tightly when the appropriate signal is applied to the operator.
 - b. Check for appropriate fail position, and that the stroke and range is as required.
10. Check each digital control point by making a comparison between the control command at the central command unit and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the ECEMS display. Record the results for each device in the ECEMS start-up report.
11. For outputs to reset other manufacturer's devices (for example, VSDs) and for feedback from them, calibrate ranges to establish proper parameters. Coordinate with representative of the respective manufacturer and obtain their approval of the installation.
12. Verify proper sequences by using the checklists to record results and submit with ECEMS start-up report. Verify proper sequence and operation of specified functions.
13. Verify that safety devices trip at appropriate conditions. Adjust setpoints accordingly.
14. Tune control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the ECEMS start-up report. Except from a startup, maximum allowable variance from setpoint for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted):
 - a. Duct air temperature: plus or minus 1-degree F.
 - b. Space temperature: plus or minus 2-degrees F.
 - c. Hot water temperature: plus or minus 3-degrees F
 - d. Duct pressure: plus or minus 0.25 inches w.g.
 - e. Water pressure: plus or minus 1 psid.
 - f. Air flow control: plus or minus 5 percent of setpoint velocity.
 - g. Space pressurization: plus or minus 0.05 inches w.g.
15. For interface and DDC control panels:

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- a. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the record drawings.
- b. Ensure that terminations are safe, secure and labeled in accordance with the record drawings.
- c. Check power supplies for proper voltage ranges and loading.
- d. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.
- e. Check for adequate signal strength on communication networks.
- f. Check for standalone performance of controllers by disconnecting the controller from the LAN. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.
- g. Ensure that outputs and devices fail to their proper positions/states.
- h. Ensure that buffered or volatile information is held through power outage.
- i. With system and communications operating normally, sample and record update/annunciation times for critical alarms fed from the panel to the Operator Interface.
- j. Check for adequate grounding of DDC panels and devices.

16. Operator Interfaces:

- a. Verify that elements on the graphics are functional and are properly bound to physical devices or virtual points, and that hot links or page jumps are functional and logical.
 - b. Output specified ECEMS reports for review and approval.
 - c. Verify that the alarm printing and logging is functional and per requirements.
 - d. Verify that trends are archiving to disk and provide a sample to the CxSP and OWNER for review.
 - e. Verify that e-mail alarm annunciation is functional.
 - f. Verify that functionality of remote operator interfaces.
 - g. Verify that required third party software applications required with the bid are installed and are functional.
 - h. Verify proper interface with fire alarm, lighting control system, photo voltaic system, gas and electrical meters.
- B. Submit start-up test report: Report shall be completed, submitted, and reviewed prior to Substantial Completion.

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3.04 SENSOR CHECKOUT AND CALIBRATION

- A. General Checkout: Verify that sensor locations are appropriate and are away from causes of erratic operation. Verify that sensor with shielded cable are grounded only at one end.
- B. Calibration: Calibrate sensors using one of the following procedures:
 - 1. Sensors Without Transmitters – Standard Application: Make a reading with a calibrated test instrument within 6 inches of the site sensor at various points across the range. Verify that the sensor reading (via the permanent thermostat, gage, or ECEMS) is within the tolerances specified for the sensor. Where sensors are subject to wide variations in the sensed variable, calibrate sensor within the highest and lowest 20 percent for the expected range.
- C. Sensor Tolerance: Sensors shall be within the tolerances specified for the device.

3.05 COIL VALVE LEAK CHECK

- A. Verify proper close off of the valves. Ensure that valve seats properly by simulating the maximum anticipated pressure difference across the circuit. Calibrate air temperature sensor on each side of coil to be within 0.5 degrees F of each other. Via the Operator Interface, command the valve to close. Energize fans. After five minutes observe air temperature difference across coil. If a temperature difference is indicated, and the piping surface temperature entering the coil is within 3 degrees F of the water supply temperature, leakage is probably occurring. If it appears that it is occurring, close the isolation valve to the coil to ensure the conditions change. If they do, this validates that the valve is not closing. Remedy the condition by adjusting the stroke and range, increasing the actuator size/torque, replacing the seat, or replacing the valve as applicable.

3.06 VALVE STROKE SETUP AND CHECK

- A. For valve and actuator positions check, verify the actual position against the ECEMS display.
- B. Set pumps to normal operating mode. Command valve closed, verify that valve is closed, and adjust output zero signal as required. Command valve open, verify position is full open and adjust output signal as required. Command the valve to various few intermediate positions. If actual valve position does not reasonably correspond, replace actuator.

3.07 ECEMS DEMONSTRATION

- A. Demonstrate the operation of the ECEMS hardware, software, and related components and systems to the satisfaction of the CxSP and OWNER. Schedule the demonstration with the OWNER's representative two weeks in advance. Demonstration shall not be scheduled until hardware and software submittals and the start-up test report are reviewed. If the work fails to be

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demonstrated to conform with contract specifications, so as to require scheduling of additional site visits by the CxSP and OWNER's representative for re-demonstration, reimburse OWNER for reasonable local costs of subsequent CxSP site visits as detailed elsewhere in these specifications.

- B. Supply personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etcetera. Contractor-supplied personnel shall be competent with and knowledgeable of project-specific hardware, software, and the HVAC systems. Training documentation and submittals shall be at the job site.
- C. Demonstration shall typically involve small representative samples of systems and equipment randomly selected by the OWNER and CxSP.
- D. The system shall be demonstrated following the same procedures used in the start-up test by using the Commissioning checklist. Demonstration shall include, but not necessarily be limited to, the following:
 - 1. Demonstrate that required software is installed on ECEMS workstations. Demonstrate that graphic screens, alarms, trends, and reports are installed as submitted. Demonstrate directory structure and file system matches that submitted.
 - 2. Demonstrate that points specified and shown can be interrogated or commanded (as applicable) from workstations, as specified, in less than the maximum response time.
 - 3. Demonstrate correct calibration of input/output devices using the same methods specified for the start-up tests. A maximum of 10 percent of I/O points shall be selected at random by the CxSP or OWNER for demonstration. Upon failure of any device to meet the specified end-to-end accuracy, an additional 10 percent of I/O points shall be selected at random by CxSP for demonstration. This process shall be repeated until 100 percent of randomly selected I/O points have been demonstrated to meet specified end-to-end accuracy.
 - 4. Demonstrate that DDC and other software programs exist at respective field panels. The DDC programming and point database shall be as submitted.
 - 5. Demonstrate that DDC programs accomplish the specified sequences of operation including failure sequences.
 - 6. Demonstrate that the panels automatically recover from power failure, as specified. Demonstrate alarms as specified.
 - 7. Demonstrate that the stand-alone operation of panels meets the requirements of these Specifications. Demonstrate that the panels' response to LAN communication failures meets the requirements of these Specifications.
 - 8. Identify access to equipment selected by CxSP or by the OWNER. Demonstrate that access is sufficient to perform required maintenance.

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9. Demonstrate that required trend graphs and trend logs are set up per the requirements. Provide a sample of the data archive. Indicate the file names and locations.
- E. ECEMS demonstration shall be completed and prior to Substantial Completion.
- F. Tests successfully completed during the demonstration will be recorded as passed for the Functional Performance Testing (FPT) and will not have to be retested.

3.08 RESOLUTION OF DEFICIENCIES

- A. Maladjustments, misapplied equipment, or deficient CONTRACTOR's performance may result in additional work being required for Cx acceptance.
 1. Perform work required to correct the installations not meeting contract requirements at no additional cost to the OWNER.
- B. Corrective work shall be completed in a timely manner to permit completion of the Cx process.
 1. Refer to Article 3.07 above, Section 01 91 13, and Cx plan for retesting requirements necessary to achieve required system performance.
 2. If the system's Cx deadline, as defined in the CxP, goes beyond the scheduled completion of Cx without resolution of the problem, the OWNER reserves the right to obtain supplementary services or equipment to resolve the problem.

3.09 ECEMS ACCEPTANCE PERIOD

- A. After approval of the ECEMS demonstration and prior to contract close-out acceptance phase shall commence. Acceptance period shall not be scheduled until HVAC systems are in operation and have been accepted, required cleaning and lubrication has been completed (i.e., filters changed, piping flushed, strainers cleaned, and the like), and Testing and Balancing report has been submitted and reviewed. Acceptance Period and its approval will be performed on a system-by-system basis if mutually agreed upon by the CONTRACTOR and the OWNER.
- B. Operational Test: At the beginning of the Acceptance Phase, the system shall operate properly for two weeks without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. At the end of the two weeks, forward the trend logs to the CxSP for review and acceptance. CxSP shall determine if the system is ready for Functional Performance Testing (FPT) and document any problems requiring CONTRACTOR attention.
 1. If the systems are not ready for Functional Performance Testing (FPT), correct problems and provide notification to the OWNER's representative that problems have been corrected. The acceptance period shall be restarted at the mutually scheduled time for an additional one-week period. This process shall be repeated until CxSP issues notice that the ECEMS is ready for Functional Performance Testing (FPT).
- C. During the acceptance period, maintain a hard copy log of alarms generated by the ECEMS. For each alarm received, diagnose the cause of the alarm, and list

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on the log for each alarm the diagnosed cause of the alarm, and the corrective action taken.

3.10 TREND LOGS

- A. Configure and analyze trends required under Section 23 09 23.

3.11 TREND GRAPHS

- A. Trend graphs as specified in Section 23 09 23 shall generally be used during the acceptance phase to facilitate and document testing. Prepare controller and workstation software to display graphical format trends during the acceptance period. Trend graphs shall demonstrate compliance with contract documents.
- B. Each graph shall be clearly labeled with HVAC subsystem title, date, and times.

3.12 WARRANTY PHASE

- A. Trending: Throughout the Warranty phase, trend logs shall be maintained as required for the acceptance period. Forward archive trend logs to the CxSP and OWNER for review. CxSP or OWNER will review these and notify CONTRACTOR of Warranty work required.

3.13 SOFTWARE OPTIMIZATION ASSISTANCE

- A. Provide the services of an ECEMS technician at the project site to be at the disposal of the CxSP and OWNER. The technician is to make changes, enhancements, and additions to control unit or workstation software that has been identified by the CxSP or OWNER during the Construction and Commissioning of the project and that are beyond the specified contract requirements. The cost for this service to include a total of 40 hour will be included with the bid. Request for assistance shall be for contiguous or non-contiguous 8-hour days, unless otherwise mutually agreed upon by the CONTRACTOR, CxSP, and OAR. The OWNER Authorized Representative (OAR) shall notify CONTRACTOR two days in advance of each day of requested assistance.
- B. The ECEMS technician provided shall be trained in the programming and operation of the controller and workstation software. If the ECEMS technician provided cannot perform every software task requested by the CxSP or OWNER in a timely fashion, provide additional qualified personnel at the project site as requested by the CxSP or OWNER.

END OF SECTION

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SECTION 23 09 23 - ENVIRONMENTAL CONTROLS AND ENERGY MANAGEMENT SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Environmental controls and energy management systems, including equipment, materials, installation, start-up, testing, documentation and training according to construction documents. The project drawings establish the scope of HVAC controls work in conjunction with the scope of work indicated in Section 23 0900: HVAC Instrumentation and Controls. This Section complements the requirements of Section 23 0900, and construction drawings for controls and system communications.
- B. Related Requirements:
1. Division 01: General Requirements.
 2. Section 01 45 23: Testing and Inspection.
 3. Section 01 79 00: Maintenance and Operations Staff Demonstration and Training.
 4. Section 01 91 13: General Commissioning Requirements.
 5. Section 21 13 13: Fire-Suppression Sprinkler Systems.
 6. Section 23 05 00: Common Work Results for HVAC.
 7. Section 23 05 13: Basic HVAC Materials and Methods.
 8. Section 23 08 00: HVAC Systems Commissioning.
 9. Section 23 08 13: Environmental Controls and Energy Management Systems Commissioning.
 10. Section 23 30 00: Air Distribution.
 11. Section 23 38 13: Kitchen Ventilation System.
 12. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.

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13. Section 26 05 00: Common Work Results for Electrical.
14. Section 26 05 13: Basic Electrical Materials and Methods.
15. Section 26 05 19: Low-Voltage Wires (600 Volt AC).
16. Section 26 05 26: Grounding and Bonding.
17. Section 26 09 23: Lighting Control Systems.
18. Section 28 31 49: Carbon Monoxide Detection and Alarm Systems.
19. Section 27 01 26: Test and Acceptance Requirements for Structured Cabling
20. Section 27 10 13: Structured Cabling (Existing Site)
21. Section 28 31 49: Carbon Monoxide Detection and Alarm Systems.
22. Project Commissioning Plan (CxP).

1.02 REFERENCES

- A. The latest version of applicable codes, standards, and references. Inspections and tests shall be in accordance with the following applicable codes and standards, except as provided otherwise herein.
1. International Electrical Testing Association – NETA.
 2. National Electrical Manufacturers Association – NEMA.
 3. American Society for Testing and Materials – ASTM.
 4. Institute of Electrical and Electronics Engineers – IEEE.
 5. American National Standards Institute – ANSI.
 6. National Electrical Safety Code – NESC.
 7. California Building Code – CBC.
 8. California Electrical Code – CEC.
 9. California Mechanical Code – CMC.
 10. Insulated Cables Engineers Association – ICEA.
 11. Occupational Safety and Health Administration – OSHA.

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12. National Institute of Standards and Technology – NIST.
13. National Fire Protection Association – NFPA.
14. American Society of Heating, Refrigerating, and Air-Conditioning Engineers – ASHRAE
(The HVAC Commissioning Process, ASHRAE Guideline).
15. International Building Code – IBC.
16. International Mechanical Code – IMC.
17. InterNational Electrical Testing Association (NETA) Acceptance Testing.

1.03 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.
- B. Shop Drawings shall include but not limited to:
 1. Cover page with legend, common notes, symbol schedule, and drawing index.
 2. Complete point to point environmental controls and energy management network communication diagram(s) for Direct Digital Controls (DDC) of each system:
 - a. Identify all components.
 - b. Indicate conduit and wire characteristics, sizes and quantities.
 - c. Provide bill of materials.
 3. Floor plans showing control panels and intercommunication wiring.
 - a. Show system(s) interface connections.
 4. Valve Schedules where required.
 5. Operations and Maintenance Manuals.
 6. As-built submittal drawings.
 7. Installation Instructions of each control device.
 8. PC Workstation.

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9. Software flow diagram of each unique system sequence of operation.
10. Software licenses and electronic keys.
11. Supplemental local or factory training schedule for post warranty support.
12. A complete list of recommended spare parts with pricing for the OWNER's use in keeping the environmental control system downtime to a minimum.
13. Composite CD-ROM with AutoCAD drawings in a ".dwg" format.

1.04 QUALITY CONTROL

- A. CONTRACTOR shall have adequate experience installing systems of similar size and complexity with the control product line proposed for this project.
 1. Qualifications of Installer: Minimum five years experience installing products and systems of similar scope and complexity.
 2. Installer shall submit certification from the equipment manufacturer indicating that installer is an authorized representative of the equipment manufacturer and is trained on network applications.
 3. Installer shall maintain a fully equipped service organization capable of furnishing repair service to the equipment and shall maintain a spare set of major parts for the system at all times.
 4. Installer shall furnish a letter from manufacturer of equipment certifying equipment has been installed according to factory standards and that system is operating properly.
 5. CONTRACTOR shall have participated in the commissioning of a minimum of 10 projects of similar magnitude to those needed for this project.
 6. System startup and testing shall be performed under the direct observation of the Project Inspector and OAR.
- B. Materials and equipment installed shall be new.
- C. System installation shall not begin until Shop Drawings are submitted and reviewed by the Architect or Engineer of Record.
- D. Components for Direct Digital Control (DDC) shall comply with ASHRAE standards.
- E. The installer shall provide the system components required by code and for the life safety of the service personnel.

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- F. System shall be able to interface with open protocol BACnet systems.
- G. Provide all ancillary components for the system to perform the required sequence of operations. Install, test and adjust the system accordingly.
- H. System components shall operate per industry standards. The standards shall be as defined by ASHRAE, SMACNA, AABC, NEBB, TABB, and the literature of the manufacturers listed in this Section.
- I. Provide field engineering tools including software and hardware needed for programming and/or modifying system controller and devices.

1.05 WARRANTY

- A. Components, system hardware and software, and parts and labor shall be guaranteed against defects in materials, fabrication, and execution for three years from date of system acceptance. Provide labor and materials to repair, reprogram, or replace defective components at no charge to the OWNER during the warranty period.
- B. Provide a list of applicable warranties for equipment and components, this list shall include warranty information, names, addresses, telephone numbers, and procedures for filing a claim and obtaining warranty services.
- C. CONTRACTOR shall respond to OWNER's request for warranty service within four hours of initial call to schedule a mutually agreeable time for service. Submit records of the nature of the call, the work performed, and the parts replaced or service rendered.

1.06 TRAINING

- A. Provide a competent instructor who is factory trained and has comprehensive knowledge of system components and operations to provide full instructions to designated personnel in the system operation, maintenance, and programming. Training shall be specifically oriented to installed equipment and systems.
 - 1. Provide four hours of onsite OWNER familiarization and training for the installed system. Training shall include system overview, time schedules, override commands, emergency operation, and programming and report generation. OWNER employees attending this training session shall be provided with the following documentation:
 - a. As-built drawings of System layouts and point to point connection diagrams.
 - b. System components cut sheets.

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- c. Operations and maintenance data.
2. Programmer and maintenance training shall include database entry; trend logs application programs, diagnostic routines, reporting, failure recovery and calibration.
- a. Provide 24 hours of training as follows:
 - 1) Training session shall accommodate a minimum of 20 persons and be facilitated at CONTRACTOR's training facility, which should be no more than 50 miles from the Project Site.
 - a) Training shall be delivered in 6 hours per session increments.
 - b) Obtain OWNER's approval for training locations exceeding 50 miles. In such cases, the CONTRACTOR shall be responsible for transportation expenses.
 - c) CONTRACTOR shall provide training computers for all attendees. Computers shall be ready for live training sessions.
 - 2) Training shall cover instruction, theory, and expose the trainees to system's features, components, architecture, operations, programming, report generation, communications, and any other pertinent information required for the operations and maintenance of the system.
 - 3) Each training session shall have an itemized agenda covering all aspects of the training to be covered in the sessions. CONTRACTOR shall obtain agendas approval from OWNER and Commissioning Agent.
 - 3) Instructor(s) shall give the trainees the opportunity to practice on simulated and actual (installed) systems.
 - 4) The training session shall cover, but not be limited to the following instruction modules or sessions:
 - a) System Architecture:
 - (1) System layout and components interrelations and hierarchical structure.
 - (2) Controllers interfacing and functions.

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- (3) Server functionality and data management, error messages, and alarm conditions.
 - (4) Connectivity and communication losses.
 - (5) Replacement procedures for system components.
- b) User Operations:
- (1) Familiarization and navigation with the EMS operating System.
 - (2) Window panes, menus, navigation buttons, alarm response windows, system passwords and accessibility features and options, monitoring and managing data points (inputs, outputs, numeric values, time and date, strings).
 - (3) Views: Provide sufficient information as to train staff on how and where to access programs, functions, adjust or alter diagnostic points and related data, override messages, reports and actions taken.
- c) Trending: Setting trend(s) intervals, accessing data trends and history logs for diagnosis points or groups, and reporting. Working with trended data graphical displays, including but not limited to hiding points, setting display types and colors, viewing and setting scales.
- d) Graphics: Standard symbols and color codes, graphics customization, how and where to access and manage the system with the graphic displays, including changing points and values, using HOA switches and viewing results, mapping to or with other graphic sources and functions, including groups, navigation, sequence of operations, and displays and reports.
- e) Alarms: Reading and interpreting alarms, acknowledging and silencing alarms, routing and setting priorities, viewing and responding e-mailed and paged alarms.

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PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Environmental controls and energy management systems shall be approved products of Carrier i-Vu.

2.02 SYSTEM ARCHITECTURE

- A. The system shall be capable of providing a peer-to-peer network of distributed stand-alone DDC controllers that meet ANSI/ASHRAE Standard 135 for open protocol communications.
- B. A maximum of 32 controllers shall be connected to any one MS/TP bus. Minimum Speed of 38kb and can support 127 devices per COM port. Provide a minimum of 2 ports.
1. Provide a Building Automation System (BAS) that consists of Network Server/Controllers (NSCs), a family of Standalone Digital Control Units (SDCUs), Administration and Programming Workstations (APWs), and Web-based Operator Workstations (WOWs). The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, WEB enable capabilities, and Wide Area Network (WAN).
 2. The Enterprise Level BAS shall consist of an Enterprise Server, which enables multiple NSCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from a single Workstation simultaneously for operations and engineering tasks. The Enterprise Level BAS shall be able to host up to 250 servers, or NSCs, beneath it.
 3. For Enterprise and robust reporting capability outside of the trend chart and listing ability of the Workstation, a Reports Server shall be provided and installed on a Microsoft Windows based computer. The Reports Server can be installed on the same computer as the Enterprise Server.
 4. The system shall be a top-level 100/1000bT Ethernet network that utilizes BACnet/IP with IP field Controllers.
 - a. A sub-network of SDCUs using the BACnet MS/TP protocol shall connect the local, and stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.
 5. The system shall match the existing LonWorks IP, and/or Modbus TCP protocol.

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- a. Integration to existing Modbus RTU/ASCII (and J-bus), Modbus TCP, LonTalk FTT-10A, and Web Services shall be native to the NSCs. There shall not be a need to provide multiple NSCs or additional software to allow all three protocols to be natively supported.
 - b. A sub-network of SDCUs using LonTalk FTT-10A, and/or Modbus RTU protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.
- C. Only systems that use HTML 5 structured language are allowed.
- D. The supplied computer software shall employ object-oriented technology (OOT) for representation of data and control devices within the system. For each global, system or unitary controller, provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3 with the ability to support data read and write functionality.
- E. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed three seconds for network connected controllers or user interfaces.
1. For each system point, alarms can be created based on high/low limits or in comparison to other point values.
 2. There is no limit to the number of alarms that can be created or stored in system hardware for any point, up to the system capacity.
 3. System shall generate configured alarms from single or multiple system conditions.
 4. Alarms will be generated from an evaluation of the alarm condition, and presented to the user in a fully configurable order, by priority, time, and category,
 - a. Alarm views shall be presented to the user upon logging into the system WorkStation and/or Webstation.
 5. Program the alarm management system to create and report alarm events history; the alarm events history data base shall provide the option to select alarm cause and action notes associated with an alarm event. The alarm management system shall also generate checklists for operators' use when utilizing a suggested mode of troubleshooting.

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6. Provide alarm event history for a feature use to permit assigning of events for resolution to OWNER staff. The system shall notify the user and assigned resolution personnel.
 7. Alarms shall be capable of being routed to any BACnet workstation that conforms to the B-OWS device profile and uses the BACnet/IP protocol.
- F. The system shall be able to interface with subsystems that utilize ANSI/CEA-709.1: Control Network Protocol Specification.

2.03 EMS SERVER AND USER INTERFACE WORKSTATION

- A. EMS Server: The EMS Server shall include a tower or rack mounted server with an Intel Xeon E5 2600 processor, 8 Gb RAM, RAID 1 configuration with two hot swap 2TB 7200 RPM SATA drive, DVDRW drive, keyboard, mouse, 27 inch LCD color display and the latest version of Microsoft Windows Server operating system software. The workstation shall connect to the network through an internal 1Gbps Ethernet interface card.
1. Software licensing shall be provided for local or remote unlimited simultaneous users of the system, unlimited future point expansion, user graphical display generation and non-vendor controllers. Licenses and electronic keys shall be included with the M&O manuals for project acceptance. Conditional Licenses will not be acceptable.
 2. The system shall be programmed to email selected alarms to designated response personnel.
 - a. The ability to utilize email paging of alarms shall be a standard feature of the operating system's mail application interface (MAPI). No special software and no email client software must be running in order for the system to distribute emails.
 - b. The email notification shall be able to be sent to an individual user or a user group.
 - c. The NSC shall support the use of Web Services based on open standards, such as SOAP and REST. Use incoming third-party data (temperature forecast, energy cost) over the Web to determine site modes, scheduling, and programming.
 3. Web-based operation shall be supported directly by the NSCs and shall not require additional software.

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4. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs.
5. Programming of SDCUs shall be capable of being done either off-line or on-line from any operator workstation. All information shall be available in graphic or text displays stored at the NSC. Graphic displays shall feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable through a mouse.
6. Programming in the NSC shall be either in graphical block format or line-programming format or both.
7. Programming of the NSC shall be available offline from system prior to deployment into the field. All engineering tasks shall be possible, except the viewing of live tasks or values.
8. The programmer's environment shall include access to a superset of the same programming language supported in the SDCUs.
9. Provided NSC devices shall support both script programming language as well as the graphical function block programming language. For both languages, the programmer will be able to configure application software for custom program development, and write global control programs. Both languages will have debugging capabilities in their editors.
10. The system shall be able to save custom programs as libraries for reuse throughout the system. A wizard tool shall be available for loading programs from a library file in the program editor.
11. The system shall be capable providing views of graphical programming in live and real-time from Workstation(s).
12. The system shall be capable of creating 'binding templates' allowing the user to bind multiple points to multiple objects all at once.
13. Automatic detecting zone that may be excessively driving the reset logic and generate an alarm.
14. Readily allow operator removal of zones from reset algorithm.
15. Applications shall be able to be assigned different priorities and cycle times for a prioritized execution of different function.

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16. The provided system shall be able to create objects that allow common objects such as power meters, VFD drives, etc. to be integrated into the system with simple import actions without the need of complicated programming or configuration setups.
17. The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user when logging into any workstation. Additionally, it shall be possible to create customized workspaces that can be assigned to user groups. This interface shall support the creation of “hot-spots” that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface shall be able to be configured to become a user’s “PC Desktop” – with all the links that a user needs to run other applications. This, along with the Windows user security capabilities, shall enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software, but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shut down the active alarm viewer and/or unable to load software onto the PC.
18. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.
19. Provide a Web Server to automatically convert system displays on the workstation to an Internet page. Internet page shall be readable from standard PC browsers. Acceptable browsers shall be latest version of internet explorer, Chrome, or Firefox. No additional plug-ins, programs, software, hardware, etc. shall be needed to access the Internet page. The server shall be a separate device to provide security protection for the building system from outside hackers.
 - a. Coordinate individual system components IP addresses, switch port assignments, security settings such as but not limited to SNMP alarm delivery, HTTPS/SSL settings, VLAN assignment and authorized IP address ranges with the OWNER’s Information Technology Division. Coordination activities with ITD shall be executed through the OAR.
 - b. Provide IP address label on the interior of each cabinet door or equipment.
 - c. The system shall support the ability to notify school or OWNER designated personnel by SMS or Email messages, utilizing the

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OWNER's mail server when problems or situations that require immediate attention arise.

20. Operator Workstation shall display data associated with the project as called out on drawings or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings. Operator's workstation shall display data using three-dimensional graphic representations of mechanical equipment. System shall be capable of displaying graphic files, text, trend data and dynamic object data together on each display screen with animation of equipment operation.
 21. Controllers shall be programmed using graphical software tools that allow connection of function blocks for visual sequencing of control logic. Function blocks shall display real time data and be animated to show status of data inputs and outputs when in real time operation. Animation shall also show change of status on logic devices and countdown of timer devices in a graphical format.
 22. Operator Tracking Log shall record operator changes to the system for future review. This shall include, but not be limited to setpoint changes, time schedule overrides, alarm limits, etc.
 23. The system shall be equipped with a battery back-up source capable of providing 30 minutes of operation (computer and monitor) in the absence of normal power, to allow for an orderly shutdown and data back-up.
- B. EMS Workstation: The EMS Workstation shall be an enterprise level tower with an Intel Core™ i7 or better processor, 16GB of RAM, 256 GB solid state drive, DVD drive, keyboard, mouse, 27 inch LCD color display and the latest version of Microsoft Windows professional operating system software. The workstation shall connect to the network through an internal 1Gbps Ethernet interface card.

2.04 GLOBAL CONTROLLER

- A. Building controllers shall incorporate the functions of a 3-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 100MHz), master slave token passing (MS/TP) LANs, a point-to-point (PTP/RS-232) connection and telephone modem.
- B. Provide global control strategies for the system based on information from any point objects in the system. Programming shall be object-oriented using graphical control function blocks. Global strategies shall include, but not limited to unit scheduling, electrical demand limiting, optimized start-stop of equipment, central plan reset control, etc.

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- C. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative). Battery shall provide up to five minutes of powerless operation for orderly shutdown and data backup.
- D. Each building controller shall support a minimum of 250 BACnet Schedule Objects and 250 BACnet Calendar Objects.
- E. Each building controller shall log a minimum 1,000 trend logs. Any point object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation. Building controller shall periodically upload trended data to networked operator's workstation for long term archiving if desired. Archived data shall be available for use in third-party spreadsheet or database programs.
- F. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes events such as analog object value changes, binary object state changes and various controller communication failures. Each alarm may be automatically dialed out to a telephone pager or emailed to any Internet PC computer.
- G. Provide a 1.5 KVA UPS with battery back-up capability to provide a minimum of 30 minutes of operation (computer and monitor) for orderly shutdown and data backup. Make connections and test the system for proper operation in the presence of the Project Inspector.
- H. The global controller shall be equipped with ADR demand limiting capacity interface.
 - 1. The system shall include 5 DI for interfacing to local utility ADR program. The 5 DI shall be located in a 24 X 24 X 6 NEMA 12 cabinet mounted in the MDF or IDF room. Upon closer of each DI the control system shall raise or lower (depend on system mode) global room temperature set point 1 degree (user adjustable).
 - 2. The system shall also include a demand-limiting program that utilizes data from site utility meter. Features indicated below shall be available via a switchable graphical user interface in all operating stations:
 - a. Shed/Restore equipment in digital format shall include 5 data input points for interface to future ADR web appliance located in an MDF/IDF room. System server shall accept ADR command from utility service via web interface, and shall include at least 5 priority levels of equipment shedding. Load shedding on a given priority level shall include two methods. In one the loads shall be shed and restored in a "first-off/first-on" mode and in the other; the loads shall be shed/restored in a linear fashion.

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- b. Adjust operator selected control setpoints in analog format based on energy usage when compared to shed and restore settings.
- c. Shedding may be implemented independently on each and every zone or piece of equipment connected to the system.
- d. Status of every load shed shall be capable of being displayed on every operator terminal connected to the system. Statuses shall be displayed along with the English description of each load.

2.05 APPLICATION (system and unitary) DDC CONTROLLERS.

- A. Application controllers shall include universal inputs with 10-bit resolution that accept 3K and 10K thermistors, 0 to 10VDC, 0 to 5 VDC, 4 to 20 mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of three inputs that accept pulses. Controller shall include support and modifiable programming for interface to intelligent room sensor with digital display, and set point adjustment and override button. Controller shall include binary and analog outputs on board. Analog outputs shall be switch selectable as either 0–10VDC or 0–20mA. Software shall include scaling features for analog outputs. Application controller shall include a supply voltage to power external sensors.
- B. Program sequences shall be stored in EEPROM or flash memory. No batteries shall be needed to retain logic program. Controller shall execute program sequences 10 times per second and be capable of multiple PID loops for control of multiple devices. Calculations shall be completed using floating-point math. Programming of application controller shall be completely modifiable in the field over the installed BACnet LANs or remotely via modem interface.
- C. CONTRACTOR shall provide a laminated wiring diagram for each control panel. Locate diagrams on interior side of control panel's doors.

2.06 TEMPERATURE SENSORS

- A. Temperature sensors shall be 10K ohm thermistor factory-calibrated to within 0.5 degrees F, totally interchangeable with housings appropriate for the application.
- B. Wall sensors shall be installed 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells filled with thermal compound. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.
- C. Intelligent room sensors shall be equipped with digital display, set point adjustment and override button. Smart room temperature sensor/thermostat shall incorporate PIR motion sensor, temperature display, set point adjustment and override button.

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Acceptable Manufacturers: Schneider Electric SE8600 series, Viconics VT8600 series, Sigler 8600 series or equal.

- D. Room thermostat shall be BACnet capable, Acceptable manufacturers: Schneider Electric SE8600 series, Viconics VT8600 series, Sigler VT8600 series or equal.

2.07 CARBON DIOXIDE (CO₂) SENSORS

- A. Sensors shall be wall mounted at a height of approximately 4 feet. Locate sensors adjacent to room thermostat.
- B. Sensors are not permitted on marker boards, between shelving, in recesses or above heat producing equipment.
- C. Sensors shall be furnished with a display window that provides continuous monitoring and sensor status readings, and with tamperproof cover.
- D. Sensors shall be gold plated for long-calibration stability, be factory calibrated and certified for a minimum of five years.
- E. CO₂ sensors shall be BACnet capable, acceptable manufacturers: Honeywell C7232A, Telaire Ventostat Wall Mount, Johnson Control CD-WRD-00-0, or equal.

2.08 WINDOWS AND DOOR SENSOR

- A. Provide windows and door switches at every operable window and in controlled spaces. Each switch shall be connected to a DI point on the DDC controller. Each switch shall be wired independently. Wiring multiple switches in series shall not be acceptable. Acceptable Manufacturers: Illumra E3-MDCCP or equal.

2.09 HUMIDITY SENSORS

- A. The humidity sensor shall be a solid-state device that is factory calibrated to provide a linear output with an accuracy of 3.0 percent from 0 to 90 percent RH. A metal fabric filter shall protect the humidity-sensing element.
- B. Duct humidity sensors shall utilize a sampling tube enclosure that is accessible for maintenance personnel.
- C. Room and duct sensors shall incorporate a temperature sensor in the same enclosure when required.

2.10 PRESSURE SENSORS

- A. Differential and pressure sensors shall have a tensioned stainless-steel diaphragm to form a variable capacitor that produces a linear output with an accuracy of 1.0

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percent of full scale. The unit shall be able to withstand 10 PSIG over pressurization.

- B. Differential pressure switches shall utilize a diaphragm operated snap-acting switch with a setpoint range of 0.05 to 2.0 inches WC.
- C. Steam pressure sensors shall be mounted on a pigtail siphon with manual shutoff ball valve.

2.11 CARBON DIOXIDE (CO₂) SENSORS

- A. Carbon dioxide concentration levels shall be sensed by non-dispersive infrared technology. A corrosion-free sensing chamber shall be used for accurate, stable CO₂ sensing. An LCD shall display sensed CO₂ concentration.
- B. Sensor shall be gold plated and have a range of 0-2000 PPM at +/- 5 percent accuracy for long-term calibration stability. Both analog and binary relay output circuits shall be available on the sensor. An automatic background calibration algorithm shall reduce required maintenance.
- C. Acceptable Manufacturers: Telaire, Honeywell, Johnson Controls, or equal.

2.12 ELECTRONIC VALVES

- A. Control Valves ½ inch to 2-inch shall be characterized stainless steel ball valves with actuators sized to close off against twice the maximum fluid pressure. Valve body shall be NPT screwed for 2-way or 3-way application. A push button release shall be provided for manual operation.
- B. Control Valves 2 ½-inch and larger shall be butterfly type with actuators sized to close off against twice the maximum fluid pressure. Valve body shall be flanged for 2-way or 3-way application. Contacts shall be provided to mechanically indicate the full open and full closed position of the valve.
- C. Steam Valves shall be globe valves suitable for 35-PSI inlet steam service. Valve bodies shall be NPT screwed or flanged with spring-return normally closed valve actuators.
- D. Valve control shall be accomplish with 2-10 VDC. All valve shall provide feedback signal to EMS/BMS for monitoring on GUI.
- E. Acceptable Manufacturers: Belimo, Honeywell, Johnson Controls, Schneider Electric or equal.

2.13 DAMPER ACTUATORS

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- A. Electric damper actuators (including VAV box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
- B. Actuators shall be sized for 200 percent of the design torque requirements.
- C. Damper actuators shall incorporate a release mechanism to manually position the damper for maintenance or emergency override.
- D. Damper Actuators located outdoors shall have a clear plastic weather shield specifically designed for the application.
- E. Damper motor control shall be with 2-10 VDC
- F. Acceptable Manufacturers: Belimo, Honeywell, Johnson Controls, Schneider Electric, or equal.

2.14 CURRENT SWITCH

- A. Current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. A multi-turn setpoint adjustment shall set the trip point status. An LED shall indicate the on or off status.

2.15 CONTROL RELAY

- A. The relay shall be contained in a plenum rated NEMA 12 enclosure with a $\frac{3}{4}$ " NPT conduit fitting. Coil voltage shall be 24 or 120 VAC with a contact rating of 10A. An LED on the enclosure cover shall indicate the relay is energized.

2.16 POWER SUPPLIES

Power supplies and panel assemblies shall be UL or NRTL listed.

2.17 ENCLOSURES

- A. Controllers, power supplies and relays shall be mounted in Hoffman A-LP NEMA 12 enclosures or equal when located in an indoor environment.
- B. Enclosures for outdoor applications shall be metal NEMA 4, Hoffman A-ALP, A-BLP or equal, and be mounted on the north exposure of the controlled unit.
- C. Enclosures shall have hinged, locking doors with common keying (CAT-60) for control panel on the Project Site.

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- D. Enclosures shall have permanently affixed to the door an engraved nametag identifying the equipment served. The nametag shall be a minimum 1 inch by 3-inch with ½ inch lettering.

PART 3 – EXECUTION

3.01 CONTROLS INSTALLATION

- A. Wiring methods for control system shall be as defined in the Division 26 specifications. Wire types shall conform to manufacturers' recommendations.
- B. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room. Control panel assemblies must be UL listed.
- C. Provide software and hardware required to provide controls and monitoring of diagnostic points indicated in specification Section 23 8000.
- D. Coordinate with Division 26 electrical installer so that "Hand/Off/Auto" selector switches are installed to override automatic interlock controls when switch is in the "Hand" position. Safety shutdown interlock wiring shall disable the equipment regardless of the position of the H-O-A switch.

3.02 ROOM SENSORS INSTALLATION

- A. Room sensors shall be wall mounted at a 48-inch height above finished floor. Room sensors are not permitted on outside walls, at chalkboards, between shelving, in recesses or above heat producing equipment. Coordinate with Division 26 for sensor or thermostat mounting adjacent to light switches.

3.03 COORDINATION

- A. Coordinate the work with other aspects of mechanical, electrical, fire-life safety and security systems, controls, and photo voltaic systems to obtain a complete and operating system in accordance with the contract documents.
- B. Meet with the OAR and school principal and other school staff to determine when each zone or building will be occupied, and to determine programming and scheduling of the heating, ventilating and air conditioning equipment.
- C. CONTRACTOR shall contact OAR to coordinate for timely availability of VPN access point(s) form OWNER's Information Technology Division.

3.04 DDC CONTROL SYSTEM ADJUSTMENTS

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- A. Make adjustments under operating conditions to provide sequence of operation for each control system per design intent. If required operating conditions cannot be obtained prior to completion date of the contract due to outdoor seasonal temperatures, return to the job site when requested by the OWNER and re-adjust control system when outdoor temperatures will permit proper operating conditions. Start re-adjustment within seven calendar days after notification.

3.05 PERFORMANCE AND ACCEPTANCE:

- A. Test and calibrate each device including but not limited to the following for proper operation, connection, signal value or response.
 - 1. Building Controllers.
 - 2. Custom Application Controllers.
 - 3. Application Specific Controllers.
 - 4. Input / Output Devices. (Sensors, actuators and monitoring devices)
 - 5. Operator Interfaces.
- B. Verify that systems are standalone and operable upon network failure.
- C. Verify that systems return to normal operation automatically upon resumption of network operation or return of power.
- D. Test each system for functions of the required control sequence of operation either by normal control operation or forced operation as required. Log and submit results.
- E. Test the network for connectivity, data transmission rates, input/output responses, and other appropriate parameters Failure modes, including network failure, individual control system failure, and power outages, shall be simulated and responses logged, with any effects on network operation noted and corrected.
- F. Test each preprogrammed time and holiday schedule.
- G. Commissioning requirements of Divisions 01, 23, and 26 apply to this Section.
- H. Schedule of Responsibilities: Refer to Appendix A. The schedule identifies the responsibilities of the CONTRACTOR for the installation of the environmental controls and energy management system. Deviations and clarifications of this schedule only if allowed by the OAR, provided trade CONTRACTOR coordination and schedule requirements are met. Submit a record copy of the Schedule of Responsibilities to the OAR at the commencement of this Section's Work.

3.06 WIRING AND INFRASTRUCTURE

- A. Provide necessary wiring, terminations, connections and conduit infrastructure for the complete system as indicated in the construction documents.

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- B. Exterior cables whether above or below ground level shall be rated for exterior applications. When entering a building provide a code sized pull box with necessary hardware to transition exterior rated cables to interior applications.
- C. Underground EMS cables are permitted to be installed with lighting control wiring in underground applications. Provide innerduct to separate EMS cables from lighting control system cables.
- D. Provide both labeling and record documentation for all EMS system cabling. A cable management schedule and diagram shall be provided at each system panel or cabinet, in addition to a complete cabling diagram to be provided at the head end equipment location.
 - 1. The cable management spread file shall include the following:
 - a. Cable Schedule.
 - b. Cable Test Forms.
 - c. Cable Label sequence and nomenclature.
 - d. Network chart.
 - 2. Cable numbering shall be based on a defined format which readily identifies cable type, and allows maintenance technicians to determine originating and terminating locations.
 - 3. Present the data in an Excel spreadsheet that will operate on the latest Windows platform. Information shall be presented in paper and electronic formats.
 - 4. A copy of the cable schedule in a transparent plastic sleeve shall be affixed in the interior side of the front door of each network cabinet or cables convergence hub points.

3.07 DATA LOGGING REQUIREMENTS

- A. The system must be capable of storing the system's collected and diagnosis data for a minimum of seven days.
- B. Program the system for a standard seven day schedule including holydays.

3.08 CLEANUP

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

3.09 PROTECTION

- A. Protect Work of this Section until Substantial Completion.

END OF SECTION

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APPENDIX A

SCHEDULE OF RESPONSIBILITIES

	ITEM	FURNISH BY	INSTALL BY	POWER BY	CONTROL WIRING BY
1	Magnetic Motor Starters:				
	a. Automatic controlled, with or without HOA switches.	E	E	E	DDC
	b. Manually controlled	E	E	E	N/A
	c. Manually controlled furnished as factory wired unit equipment	M	M	E	E
	d. Special duty type (part winding, multi-speed, etc.)	M	See Note 1	E	See Note 1
	e. Adjustable frequency drives with or without manual bypass.	DDC	E	E	DDC See Note 2
	f. Domestic booster pump. Motor Controls	M	M	E	DDC
2	Line voltage contactors.	E	E	E	DDC
3	Control relay transformers (other than starters).	DDC	DDC	E	DDC
4	Control and Instrumentation panels	DDC	NI	E	DDC
5	Automatic control valves, automatic dampers and damper operators, solenoid valves, insertion temperature and pressure sensors including wells	DDC	M	E	DDC
6	Control interlock wiring between chillers, pumps, cooling towers, fans and air handling units and other miscellaneous mechanical equipment.	DDC	DDC	E	DDC
7	Duct Smoke Detectors	E	M	E	E
8	Dampers				
	a. Control Dampers	M	M	N/A	DDC
	b. Smoke Dampers and Combination Fire/Smoke Dampers	M	M	E	E
9	Airflow Stations with transmitter.	M	M	E	DDC
10	Air terminal devices (I.e., VAV and fan powered boxes).	M	M	E	DDC
11	Intelligent Devices and Control Units provided with packaged mechanical equipment such as: Large VAV and constant volume package units Boilers and Chillers.	M	M	E	NI
12	Intelligent Devices and Control Units not provided by equipment manufacturer such as: Air handling units, Heat pumps, AC units (small < 20 tons), Air terminal units (VAV boxes)	DDC	DDC	E	DDC
13	Intelligent Devices and Control Units provided with electrical systems such as: Occupancy / motion sensors, Lighting Control Panels, Switches and dimmers, Switch Multiplexing Control Units, Door Entry Control Units.	E	E	E	DDC
14	Gateways for proprietary non-BACnet equipment	M	M	E	DDC
15	Communications network devices such as Routers, Bridges and Repeaters.	DDC	DDC	DDC	DDC
Abbreviations					

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DD	DDC CONTRACTOR (controls
C	CONTRACTOR)
M	Mechanical CONTRACTOR
E	Electrical CONTRACTOR
N/A	Not Applicable

Notes:

1. Magnetic motor starters (special duty type) shall be set in place under electrical division except when part of factory wired equipment, in which case they shall be set in place under mechanical division.
2. Where a remote motor disconnect is required in addition to the one provided integral to a Variable Frequency Drive (VFD), controls CONTRACTOR shall provide the necessary control interlock between the disconnects.

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SECTION 23 30 00 - AIR DISTRIBUTION

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Ductwork and appurtenances required for a complete air transmission and distribution system for the heating, ventilating, and air conditioning systems indicated on Drawings and as specified.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 09 90 00: Painting and Coating.
 - 3. Section 23 05 00: Common Work Results for HVAC.
 - 4. Section 23 08 00: HVAC Systems Commissioning.
 - 5. Section 23 05 13: Basic HVAC Materials and Methods.
 - 6. Section 23 05 48: HVAC Sound, Vibration and Seismic Control.
 - 7. Section 23 07 00: HVAC Insulation.
 - 8. Section 23 09 00: HVAC Instrumentation and Controls.
 - 9. Section 23 09 23: Environmental Control and Energy Management Systems.
 - 10. Section 23 38 13: Kitchen Ventilation System.
 - 11. Section 23 80 00: Heating, Ventilating and Air Conditioning Equipment.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 05 00: Common Work Results for HVAC.
- B. Manufacturer's Data:
 - 1. Complete list of items to be furnished and installed under this Section. Material lists that do not require performance data shall include manufacturer names, types and model numbers.

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2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements.
3. Literature shall include descriptions of equipment, types, models, sizes, capacity tables or curves marked to indicate performance characteristics, electrical requirements, options selected, space requirements, including allowances for servicing, and other data. Data shall include name and address of nearest service and maintenance organization that regularly stocks repair parts. Listings of items that function as parts of an integrated system shall be furnished at one time.
4. Submit complete acoustical test reports showing that proposed products have been tested in accordance with latest editions of relevant ASHRAE and AHRI Standards (ANSI/ASHRAE Standard 70 for air inlets and outlets; ANSI/ASHRAE Standard 130 and AHRI 880 for terminal units) and will be suitable for operation in Project spaces with specified maximum noise criteria (NC) requirements. The results of all testing shall be certified by an independent testing agency and submitted to the ARCHITECT for approval. The submittal shall include a complete description of the test conditions, methods and procedures.
5. Submittals shall include a tabulation of proposed products, identification of Project spaces where proposed products are to be installed, maximum allowable NC for all Project spaces, and product NC (at specific design air volume) for all Project spaces.
6. Shop Drawings: Shop Drawings indicating methods of installation of equipment and materials, sizes and gages of ducts, and details of supports. Items to be covered shall include but not be limited to following:
 - a. Layout of ductwork and equipment drawn to scale to establish that equipment will fit into allotted spaces with clearance for installation and maintenance. Indicate proposed details for attachment, anchoring to, and hanging from structural framing of building. Indicate vibration isolation units, foundations, supports, and openings for passage of pipes and ducts.
 - b. Drawings indicating locations and sizes of sleeves and prepared openings for pipes and ducts.
 - c. Typical details of supports for equipment and ductwork.

1.03 QUALITY ASSURANCE

- A. Installer's and Manufacturer's Qualifications: Comply with provisions stated under Section 23 05 00: Common Work Results for HVAC.

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- B. Sound power level measurements and Manufacturers' NC value calculations shall be conducted in complete accordance with the latest version of ANSI/ASHRAE Standards 70 and 130 and AHRI 880.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Comply with provisions stated in Section 23 05 00: Common Work Results for HVAC.
- B. Ensure ducts are clean and free of dirt, dust, moisture, oils and other contaminants that can lead to poor air quality. Cover openings of ductwork with a self-adhering protective film. Film shall not leave a residue on metal after removal, and shall be highly resistant to tears and punctures.

1.05 COORDINATION

- A. Coordinate activities in accordance with provisions of Section 23 05 00: Common Work Results for HVAC.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Unless otherwise noted, provisions, including amendments thereto, of the latest edition of the HVAC Duct Construction Standards of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) and the California Mechanical Code (CMC), are hereby made part of this Section.
- B. Rectangular, round and flat oval ducts shall be manufactured and installed in accordance with requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA.
- C. Sheet metal ducts shall be fabricated from galvanized steel, aluminum or stainless steel.
- D. Galvanized steel ducts shall be fabricated of galvanized steel sheet, lock forming grade, conforming to ASTM A653 and A924.
- E. Galvanized steel ducts gage thickness and permissible joints and seams of ductwork shall conform to requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA and the CMC unless noted otherwise on the drawings. The more stringent requirements shall prevail.
- F. Button punch snap-lock seams, using Lockformer or equal, shall be permitted only in concealed areas using 20 and 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.

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- G. Ducts shall be reinforced in accordance with the latest edition of the SMACNA HVAC Duct Construction Standards: Cross-braced Duct: Duct sizes 19 inches wide and larger which have more than 10 square feet of unbraced panel shall be beaded or cross-braced. This requirement is applicable to 20 gage or less thickness and 3 inches w.g. or less pressure. For details, refer to SMACNA manual.
- H. Round and Oval Galvanized Steel and Aluminum Ducts:
1. Round Spiral Ducts and Fittings: Fabricated from galvanized sheet steel shall be machine-formed spiral pipe with sealed spiral locking joints. Fittings shall be furnished with continuous corrosion-resistant welds. Provide gages of ducts and fittings recommended by manufacturer.
 2. Details of seams and transverse joints for round duct and fittings shall conform to SMACNA standards.
 3. Flat oval ducts shall be provided as indicated on the Drawings. Reference standard details in SMACNA manual.
 4. Minimum duct wall thickness, and permissible joints and seams of ductwork for flat oval duct construction shall conform to requirements in the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA and the CMC. The more stringent requirements shall prevail.
 5. These provisions apply for ducts furnished for indoor comfort heating, ventilating and air conditioning service only.
- I. Flexible Ducts
1. Flexible duct shall be non-metallic, insulated for conditioned air supply and return. The flexible ducts shall be factory fabricated with exterior reinforced laminated vapor barrier, 1 ½-inch thick fiber glass insulation (K = 0.25 at 75 degrees F), encapsulated zinc-coated spring steel wire helix and impervious, smooth, non-perforated interior vinyl liner and factory fabricated steel connection collars. For the composite assembly, including insulation and vapor barrier, comply with NFPA Standard 90A or 90B and tested in accordance with UL Standard, UL 181. Non-insulated metallic ducts shall be provided for exhaust only.
 2. Methods of installations, standards for joining and attaching, and supporting flexible duct shall conform to applicable provisions of SMACNA manual.
 3. Specifications herein shall not supersede installation requirements by flexible duct manufacturer if those are more stringent.
- J. Aluminum Ducts:

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1. Material for aluminum duct shall be of 3003-H14 alloy aluminum sheets, with such designation embossed or stenciled on each sheet. Minimum tensile strength shall be 19,000 psi.
 2. Aluminum duct thickness and permissible joint and seams shall conform to requirements of the latest edition of the HVAC Duct Construction Standards-Metal and Flexible of SMACNA, and CMC.
 3. Aluminum ductwork shall be furnished to transport moisture-laden air from shower rooms, shower drying rooms, dishwashers and discharge ducts from evaporative condenser and cooling towers.
 4. Unless otherwise noted, follow SMACNA Duct Construction Details for steel construction standards as indicated for unreinforced duct, reinforced duct, or cross-broken duct.
 5. Button punch snap-lock seams on aluminum ducts are not permitted.
- K. Stainless Steel Duct:
1. Materials for stainless steel duct shall be stainless steel conforming to ASTM A167 and A480.
 2. Stainless steel ducts shall be provided as required and indicated on the Drawings.
 3. Fume hood exhaust shall be stainless steel Type 304.
 4. Kitchen exhaust duct system shall be stainless steel Type 304.
 5. Stainless steel ducts shall be constructed with welded joints except for connections to equipment which shall be flanged joints with gaskets.
 6. Entire stainless steel duct systems shall comply with current CMC requirements for product conveying ducts except where the requirements of this Section are more stringent.
- L. Fittings and Other Construction Details: Details of fittings such as elbows, turning vanes, branch take-off and connections, duct access doors, connections for grilles, registers and ceiling diffusers, flexible connector at fan, etcetera, shall conform to applicable provisions of this Section or SMACNA manual.
- M. Duct Seam and Joint Sealant: Provide sealant for metal ducts at duct joints which are defined as transverse joints between duct sections including girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections, access doors and frames, and abutments to building structure. Also provide the same at duct seams which are defined as longitudinal joint between

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duct sections. Spiral lock seams in factory fabricated round or oval ducts are excluded.

1. Sealant for low-pressure ducts shall be: Design Polymerics DP1010 or DP1020, Childers CP-145A/CP-146 Chil-Flex, Foster's 32-19 Duct-Fas, Miracle-Kingco Glenkote Seal-Flex, Ductmate Industries PROseal or FIBERseal, or equal.
2. Provide sealing material for medium-pressure ducts as described in the SMACNA manual for those pressures.
3. Sealant materials shall comply with the flame spread and smoke developed rating of current CMC when tested in accordance with ASTM E84.
4. Sealant for exposed to weather ducts shall pass the Weather Resistance Test per ASTM G154 at 2000 hours QUV.

N. Restrictions:

1. Zinc-coated steel duct shall not be installed for ductwork transporting moisture-laden air. Flexible duct may only be furnished where specifically indicated on Drawings. Aluminum ducts shall not be installed for internal pressures above 2 inches of water.
2. Fiberglass duct is not permitted as a substitute for sheet metal duct.

2.02 DAMPERS

A. Manually Operated Volume Control Dampers:

1. VD-1, Rectangular: Multi-blade type, opposed blade operation, 16 gage galvanized steel blades; center pivoted on 3/8 inch diameter steel trunnions; interlocking edges; dampers shall be in own angle frame, full duct size as indicated on Drawings; frame of minimum 16 gage steel channel construction. Provide with damper operator and axles positively locked to blade. Ruskin MD35, Pottorff MD-42, Greenheck MBD-15 or equal.
2. VD-2, Round: Frame shall be constructed of not less than 20 gage galvanized steel, blades of not less than 20 gage galvanized steel channel construction with factory neoprene seals, 1/2 inch diameter axle shafts and locking hand quadrant. Ruskin MDRS25, Greenheck MBDR-50, or equal.
3. VD-3, Oval: Frame shall be constructed of not less than 14 gage galvanized steel channels with factory blade seals of not less than 12 gage galvanized steel with not less than 1/2 inch diameter axle shafts. Provide Ruskin standard construction for frame, blade and axle size, thickness and material variation. Provide adjustable locking hand quadrant. Ruskin CDO25, or equal.

B. Motorized Volume Control Dampers:

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1. MVD-1, Rectangular: Multi-blade type opposed blade operation, 16 gage minimum steel channel frame construction; 16 gage galvanized steel blades center pivoted on ½ inch diameter steel trunnions. Interlocking edges. Dampers shall be in own angle frame. Full duct size as indicated on the Drawings. Provide with matching two position motorized actuator with linkages, 24VAC by Belimo, Honeywell, Invensys, or equal. Ruskin CD35, Pottorff CD-42, Greenheck VCD Series, or equal.
2. MVD-2, Round: Butterfly type constructed with minimum 20 gage galvanized steel frame with steel angle reinforcement on above 20-inch diameter. Blade shall be 14 gage minimum thickness. Neoprene seal to ensure air tightness in closed position. Furnish with matching two position motorized actuator with linkage 24 VAC by Belimo, Honeywell, Invensys, or equal. Ruskin CDRS25, American Warming and Ventilating (AMV) VC-25, Air Balance, Inc. AC530, or equal.
3. Electronic Damper Actuators: Belimo, Honeywell, Invensys, or equal.
 - a. Sized for torque required for damper seal at load conditions.
 - b. Coupling: V-bolt dual nut clamp with a V-shaped toothed cradle. Aluminum clamps or set screws are not acceptable.
 - c. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. Actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
 - d. Power Requirements: As indicated on Drawings.
 - e. Actuator Timing: Shall meet 15 seconds.
 - f. Temperature Rating: Actuator shall have a UL 555S listing by damper manufacturer for 350 F.
 - g. Auxiliary Switches: Provide for signaling, fan control, and position indications.

C. Automatic Fire Dampers:

1. FD, Fire Dampers: Shall conform to requirements of and be listed by State of California Fire Marshal and NFPA 90A. Dampers shall provide airflow resistance not to exceed 0.05 inch water gage static pressure at 900 fpm or 0.25 inch water gage at 2,000 fpm. Dampers shall be installed in required steel sleeve at each penetration of a rated partition.
 - a. Vertical-mounted fire dampers: Fire damper shall be curtain type with blades removed from the air stream to allow for maximum free area. Dampers will be provided in factory sleeves as tested and listed by

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manufacturer. Dampers shall be rated for 1 ½ hours for installation in one or 2-hour partitions. Provide UL listed fusible links of adequate size and temperature rating. Dampers will be installed according to the manufacturer's recommended installation instructions provided with units. Provide suitable access for inspection and servicing of each damper. Pottorff VFD-10/VFD-10D Series, Ruskin IBD/DIBD Series, Greenheck FD/DFD Series, or equal.

- b. Ceiling fire dampers: Ceiling fire dampers shall be butterfly type with ceramic material to minimize heat radiation. Dampers shall be rated for one hour and shall be furnished as a part of an integral sleeve ceiling box that will accept air distribution, have a UL listed and pre-mounted hanger tabs. Dampers shall be installed according to the manufacturers recommended installation instructions. Pottorff CFD-15 Series, Ruskin CFD Series, Greenheck CRD-1 Series/CRD-2, or equal.
- c. Combination fire and smoke dampers: Combination fire and smoke dampers shall be louver bladed type. Units shall be tested and listed under UL 555 and UL 555S. Rating 1 ½ hours for installation in one or 2-hour partitions. The seals shall be non-degradable steel to steel. Leakage shall not exceed 15 cfm/sq. ft. at one inch w.g. and shall be tested at 850 degrees F. Dampers shall be capable of being remotely controlled and reset for pressurization and smoke evacuation. Fire-releasing device shall be UL 33 listed melting fusible links. Dampers shall be provided in sleeves with pre-mounted non-stall motor actuators and dual-position indicators for remote annunciation, if required. The complete assembly shall be factory cycled and tested prior to shipment. Provide suitable access for inspection and servicing of each damper. Pottorff FSD-141 with non-stall motor, Ruskin FSD37 or FSD60 with electric fuse link Model EFL 200, with electric non-stall motor, Greenheck FSD Series, with non-stall motor, or equal.

2. Electronic Damper Actuators: Refer to Sub-paragraph 2.04.B.3.

- D. Relief Dampers: Parallel multi-blade, counter balanced type with adjustable counter weights. Constructed of 20 gage galvanized sheet steel or extruded aluminum with solid stops all around. Bearings shall be dust proof, ball bearings. Damper shall open on a positive pressure of 0.01 inch within space and close to a backdraft. Interlocking edges shall prevent dust infiltration when closed. Air Balance, Inc., Pottorff, Ruskin, Metal Form Manufacturing Co. Inc., or equal.
- E. Duct Access Panels: Provide factory fabricated access panels in ducts where required for servicing fire or smoke dampers, and at other locations as specified in this Section. Units shall consist of removable panel, gasketed and pressure sealed by controlled spring tension locks. Construct unit, including interior parts, of same material as duct. Units shall be constructed to be suitable for installation in systems of up to 5 inches water gage static pressure.

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2.03 AIR DISTRIBUTION DEVICES

A. General:

1. Grilles, registers, diffusers and appurtenances shall conform to requirements specified herein and shall be of type and sizes as specified and indicated on Drawings. Performance shall be in accordance with ANSI/ASHRAE Standard 70 including airflow velocity, pressure, temperature, and sound measurements.
2. Sponge neoprene, rubber, vinyl or felt border gaskets shall be provided for surface-mounted registers, grilles or diffusers.
3. The noise generating characteristics of all specified grilles, registers, and diffusers shall be tested to, and comply with, all requirements of this specification. Representative samples shall be subjected to tests in accordance with applicable standards and procedures in order to demonstrate such compliance. A special test for this project is not required if the manufacturer has previous certified test results that can be made applicable to this project. Maximum Sound Levels of diffusers, grilles and registers shall be as follows:

Administrative office area:	NC 30
Classrooms:	NC 20
Libraries and other noise sensitive areas:	NC 25
Gymnasiums, cafeterias, lockers areas:	NC 30
4. Provide suitable frame types to match the ceiling types as specified or indicated on the Architectural Drawings.
5. Ceiling diffusers shall be provided with equalizing grids.
6. Ceiling mounted grilles, registers and diffusers shall be provided with a factory applied, baked enamel, dull finish, bone white to match acoustical ceiling tile.
7. Grilles or registers mounted on painted walls or other surfaces shall be furnished with a baked prime coat and finish painted in accordance with Section 09 9000: Painting and Coating.
8. Do not provide opposed blade dampers at diffusers and registers to balance the airflow, as they tend to create noise. Provide a manual volume damper at each branch take-off and also at branch duct to each diffuser and register upstream of the flexible duct connections. Air throw patterns shall be as indicated on the drawings.
9. Diffusers, registers and grilles indicated or scheduled on the drawings to comply with special requirements shall take precedence over the standard items specified.

B. Ceiling Diffusers - Round, Square, Rectangular:

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1. CD-1 For non-classroom areas of less than 10 feet ceiling height only. Units shall be square or rectangular modular core type as indicated on the drawings. Anemostat QC Series, Krueger Model 1240, Price SMCD Series, Titus MCD Series, or equal.
 2. CD-2 For typical classrooms. Units shall be square plaque type. Anemostat PG Series, Krueger Model PLQ, Price SPD Series, Titus OMNI Series, or equal. The horizontal air discharge pattern shall be 360-degree radial type with factory installed blank-offs for three way, two way corner, two way opposite, or one way discharge pattern.
 3. CD-3 For non-classroom areas of higher than 10 feet ceiling height. Units shall be square or rectangular louver faced type. Anemostat D Series, Krueger Model SH, Price SMD/AMD Series, Titus TDC/TDC-AA Series, or equal.
 4. CD-4: Units shall be round, adjustable pattern, and surface-mounted type. Anemostat C-27, Krueger RM Series, Price RCDE Series, Titus TMR Series, or equal.
 5. CD-5: Units shall be adjustable linear slot type. Anemostat SLAD Series, Krueger Model 1900, Price AS Series, Titus FL Series, or equal.
- C. Grilles - Return, Exhaust, Ceiling, Square, Rectangular:
1. GR-1 Acoustical Tile on Plaster Ceiling: Return and exhaust grilles shall be single deflection type with horizontal fixed face bars set at straight or 45 degree angle, ½ inch spacing and flush and flanged for surface mounting. Anemostat S3HD Series, Krueger Model S80/S85, Price 500/600 Series, Titus 350/355 Series, or equal.
 2. GR-2 Prefabricated Acoustical Tile Ceiling with Inverted Exposed T-Bars: Return and exhaust grilles shall be with single deflection horizontal fixed face bars, set at straight or 45 degree angle, ½ inch spacing and flush, lay-in panel type with nominal overall dimension of 24-inch by 24-inch. Anemostat Type SAC3L Series, Krueger Model S80/S85, Price 500/600 Series, Titus 350/355 Series, or equal.
- D. Registers, Supply, Return, Wall:
1. WR-1: Sidewall supply register shall be double deflecting type with loose key-operated opposed blade volume control. Anemostat S2 Series, Krueger Model 80/880, Price 500/600 Series, Titus 300 Series, or equal.
 2. WR-2: Sidewall return register shall be single deflecting type with horizontal fixed face bars set at 45 degree angle flush and flanged for surface mounting and complete with loose key-operated opposed blade volume

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control. Anemostat S3 Series, Krueger Model S80/S85, Price 500/600 Series, Titus 350/355 Series, or equal.

2.04 SOUND ATTENUATING EQUIPMENT - DUCT SILENCERS

- A. Provide factory fabricated duct silencers of tubular or rectangular type, for high or low velocity service, with arrangements, sizes and capacities as indicated on Drawings. Construct silencers of galvanized steel with casing seams sealed or welded to be airtight at a pressure differential of 8 inches water gage between inside and outside of unit, and stiffen or brace as required to prevent structural failure or deformation at same condition, or audible vibration during normal operation. Filler material shall comply with the following:

Fire Safety Standards:	NFPA 90A and 90B
Temperature:	ASTM C411
Air velocity:	ASTM C1071, UL 181
Fire Hazard Classification:	ASTM E84, UL 723-Class 1, NFPA 255
Corrosion Resistance:	ASTM C739, C665
Fungi Resistance:	ASTM G21
Water Vapor Sorption:	ASTM C1104, less than 1 percent by weight
Formaldehyde, Phenoloc Resins or other Volatile Organic compounds:	0 percent.

- B. Select and provide silencers from acoustical and aerodynamic rating tables based on actual test readings or interpolated values of such readings obtained from tests made by recognized independent laboratories. Tests shall be in accordance with ASTM E477.
- C. Select and provide silencers for air pressure drops not exceeding those indicated on Drawings, and of types, sizes and models for which noise reduction values, dynamic insertion loss, in decibels reference 10 to 12 watts, are not less than indicated on Drawings.

2.05 ZONE TEMPERATURE CONTROL DEVICES

- A. Variable Air Volume Control Terminals:

1. VAV-1: AHRI 880 certified, single duct, pressure independent, variable air volume control terminal with reheat coil, sound attenuators, multi-point flow sensor, electric actuators and electronic direct digital controls. The controllers shall comply with Section 23 0923: Environmental Control and Energy Management Systems. The coils shall be copper tubes with copper fins. Casings shall be 22 gage galvanized steel lined with minimum ½ inch, 1.5 pound density, foil faced insulation that complies with NFPA 90A and UL 181.
- Anemostat, Krueger, Price, or equal.

2.06 SMOKE DETECTORS

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- A. Refer to Section 28 31 00: Fire Detection and Alarm.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 DUCTWORK

- A. Construct ductwork according to details of fabrication and methods of support, as indicated in the SMACNA manuals and CMC, unless specified or indicated otherwise in this Section or on Drawings. In event of conflict, the most stringent requirement shall be provided.
- B. Unless otherwise required, construct ducts to conform accurately to dimensions indicated and to be straight and smooth on inside, with joints neatly finished.
- C. Duct dimensions indicated are net inside dimensions.
- D. Where aluminum is welded, provide a minimum thickness of 16 gage, and use gas inert tungsten process of welding.
- E. Anchor ducts to building structural slab, framing and roof decking and detail method of anchoring and fastening if not indicated on Drawings. Supports shall be seismically constructed as required by the latest edition of the SMACNA guidelines.
- F. Construct and install ducts to be completely free from vibration under operating conditions.
- G. Indicate on layout drawing, required for suspended ductwork, location of supports, loads imposed on each fastening or anchor, typical details for anchorage, and details for special anchorage for supports attached to metal roof decking.
- H. Attach supports only to building structural framing members and concrete slabs.
- I. Where supports are required between structural framing members, detail and install suitable intermediate metal framing.
- J. Ducts transporting air-conditioned or heated supply air shall be insulated in accordance with requirements of Section 23 0700: HVAC Insulation.
 - 1. Ducts exposed to weather shall be prefabricated double wall type from HVAC equipment through building envelope.

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- K. Ferrous angles and structural members and joining collars specified for construction and support of ductwork and plenums shall be primed with one heavy coat of required asphaltic aluminum paint before installation or fabrication. Metal surfaces shall be thoroughly cleaned before installation of paint. Galvanizing may be provided instead of painting. Installed duct hanger rods concealed in furred ceilings and walls are not required to be primed or painted.
- L. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.

3.03 DUCT CONSTRUCTION

- A. Minimum ductwork gages, joints, reinforcing, and bracing of ductwork shall conform to SMACNA and CMC. The most stringent standards shall prevail. Additional bracing shall be provided to prevent objectionable panel vibration.
- B. Button punch snap-lock seams, using Lock-former or equal, shall be permitted only in non-accessible areas using 20 and 22 gage galvanized steel ducts with screws added at the ends. Button punch snap-lock is not permitted for aluminum or duct lighter than 22 gage.
- C. Provide longitudinal seams of the grooved snap lock, or Pittsburg and standing, sealed spiral or continuously welded.
- D. Ferrous angles and structural members and joining collars specified for the construction and support of ductwork and plenums shall be primed with one heavy coat of asphalt aluminum paint before installation or fabrication. The metal surface shall be thoroughly cleaned before application of the paint. Galvanizing may be provided instead of painting. Installed duct hanger rods concealed in furred ceilings and walls is not required to be primed or painted.
- E. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.
- F. S-type or drive-slip type girths or longitudinal seams shall not be furnished for ductwork installed outdoors or mounted on roofs.
- G. Broken places in galvanized coating shall be acid washed and then completely soldered over or painted with galvanizing paint.

3.04 DUCT ELBOWS AND TURNING VANES

- A. Duct elbows, including supply, exhaust, and return, shall be provided with a centerline radius of 1.5 times duct width parallel to radius whenever possible; centerline radius shall not be less than width of duct parallel to radius.

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- B. Where space does not permit above radius, or where square elbows are indicated on Drawings, turning vanes shall be installed whether indicated on Drawings or not.
- C. Turning vanes shall conform to SMACNA and CMC.

3.05 DUCT JOINTS AND SEAMS

- A. Conditioned air supply ducts shall be furnished with joints and seams sealed, welded for air tightness, except spiral seam factory machine formed duct components. Spiral seam is exempted. Joints between slip-fit components may be assembled with all seams and joint connections fastened with screws.
- B. Other ducts shall be furnished with joints and seams sealed by using sealant, taping, soldering, or welding. Ducts for grease hood exhaust shall be furnished with grease-tight welding or brazing on external surface for joints and seams. Fiberglass ducts shall be provided with a thermally activated closure system, Johns Manville Fortifiber Therm-Lock with Automatic Bond Indicator dots, or equal.
- C. S-slip or drive-slip type girths or longitudinal seams are not permitted on exterior or exposed rooftop mounted ductwork.
- D. Caulking, taping, or other joint or seam treatment shall be provided in accordance with recognized standards.
- E. Seams around fan, coil housing and plenums shall be sealed with gaskets or sealing compound to provide an airtight assembly.
- F. Stainless steel ductwork connected to range hoods and fume hoods shall be provided with grease-tight, gas tight welded seams, and shall be constructed and installed so that grease or other material cannot become pocketed in any portion thereof, and system shall slope downward toward hood not less than 1/4 inch per lineal foot. Gasketed flanged joints with sealing compound shall be used only at fan and fume hood connections.
- G. Alternative duct connectors such as Ductmate Industries, Mez Industries, or equal may be used if the following conditions are met:
 - 1. One of the specifically listed connectors is submitted and approved by the ARCHITECT and OAR.
 - 2. The correct size connector, application, and gage of material conform to SMACNA Standards.
 - 3. The connector is installed per manufacturer's specifications.

3.06 DUCT TRANSITION

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- A. Slopes in sides of transition pieces shall be no greater than 1 to 5. Abrupt changes or offsets in duct system are not permitted, except when reviewed by the ARCHITECT.

3.07 DUCT TEST HOLES

- A. Holes in ducts and plenums shall be provided for pilot or static tubes for obtaining air measurements to balance or check air systems. Holes shall be covered with neoprene gasketed sheet metal cover or plugged with a fitted neoprene plug chained to duct.

3.08 SOUND ATTENUATING EQUIPMENT

- A. Install sound attenuators where required and indicated on Drawings. Refer to manufacturer's instructions for required installation.

3.09 FLEXIBLE CONNECTIONS

- A. At points where sheet metal connections are installed to fans or air handling units, or where ducts of dissimilar metals are connected, a flexible connection of commercial grade, Duro Dyne Durolon, Ventfabrics Ventglas, Ductmate Industries Proflex, or equal, non-combustible material shall be installed and securely fastened by zinc-coated steel clinch-type bands or a flange type connection. Inlet and outlet openings shall be axially in-line, maximum deviation of centerline shall be less than 5 percent of diameter or shortest dimension of a rectangular inlet of fan or air handling unit, with system at rest. Duct end of connection shall be seismically restrained if more than 4 feet from last support.

3.10 AIR TERMINAL DEVICES

- A. General: Install supply devices after ducts, plenums, and casings have been cleaned and blown free of small particles, as specified. Devices shall be aligned to be parallel to ceiling construction or walls and ceiling surfaces, and shall be pulled tightly to compress gaskets and to fit neatly against surfaces.
- B. Diffusers: Support surface mounted ceiling diffusers from angles or channels resting on and fastened to ceiling construction. Do not support from ducts. Install lay-in diffusers on T-bar ceilings with hanger wires from each corner and not supported by ceiling structure. Provide sheet metal adaptor box above each diffuser to allow space for volume controller with round collars for connection to round ducts where indicated on Drawings. Fasten duct-mounted diffusers to duct collars.
- C. Registers and Grilles:
 - 1. Install wall supply registers at least 6 inches below ceiling, unless otherwise indicated. Locate return and exhaust registers 6 inches below ceiling unless otherwise indicated.

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2. Support ceiling diffuser type inlets, registers, and grilles as required above for ceiling diffusers.
3. Fasten wall mounted and duct mounted registers and grilles to flanges of duct collars.

3.11 DAMPERS

- A. Manually operated dampers, gravity dampers, fire dampers, and motor operated dampers shall be furnished and installed as specified and indicated. Upon completion of installation, dampers shall be checked, lubricated, and adjusted so that they operate freely, without binding. Dampers shall be of standard commercial manufacture, complete with damper frame. Where painting is required, they shall be shop finished unless otherwise noted.
 1. Provide and install manual volume dampers per SMACNA standards to allow balancing per AABC, NEBB or TABB Procedures and Standards whether indicated on the drawings or not.
 2. Balancing dampers shall be installed in main supply ducts from fan discharge plenums, where two or more ducts are connected to each plenum, although such balancing dampers may not be indicated. Each zone shall be provided with a manual volume damper. Sheet metal screws shall be installed through handles and into ducts to lock damper in place after test and balance.
 3. Each supply, return, and exhaust branch shall be provided with manual volume dampers.
 4. Do not provide opposed blade dampers at air inlets and outlets.
 5. Each supply, return, and exhaust inlet or outlet shall be provided with a manual volume damper. This damper shall be a minimum of 5 feet upstream of the air outlet and inlets. An acoustic flexible duct should be provided between the outlet and inlet and the damper for concealed ducts.
 6. Dampers installed in accessible locations shall be provided with locking and indicating quadrants. Ventfabrics Ventlok, Duro Dyne, Young Regulator Co., or equal.
 7. Dampers installed in ductwork in furred ceiling spaces or in roof spaces with less than 30 inches of clearance below beams, joists, or other construction, and where access panels are not provided shall be furnished with damper rods extended below ceiling and terminated with a concealed damper regulation. Ventfabrics Ventlok, Young Regulator Co., Duro Dyne, or equal.
 8. Dampers not identified as splitter, extractor, or butterfly dampers shall be of multi-louver type arranged for opposed blade operation. Damper shall be same

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dimension as adjoining duct and be tight closing. Blades shall not be greater than 9 inches. Dampers shall be not less than 18 gage steel.

9. Motor operated dampers shall be furnished by temperature control manufacturer as part of temperature control equipment and shall conform to requirements of Section 23 0900: HVAC Instrumentation and Controls.
10. Dampers shall be provided with accessible operating mechanisms. Where operators are exposed in finished portions of building, operators shall be chromium-plated with exposed edges rounded. Splitter dampers are not permitted unless specified and reviewed by the ARCHITECT.
11. Dampers shall not be installed in combustion air ducts.
12. Access panels shall be installed for access at each damper's operating mechanism.

3.12 FIRE AND SMOKE DAMPERS

- A. Fire dampers or combination fire and smoke dampers shall be installed and accessible at duct penetrations of rated walls and partitions and as required by State Fire Marshal and NFPA 90A, 92A, 92B, and 101.
- B. Fire dampers shall be sized, and adjoining duct enlarged, to assure full size air passage of connecting ductwork.
- C. Install smoke dampers as indicated on Drawings and as required in ducts penetrating smoke isolation separations.
- D. Fire dampers or combination fire and smoke dampers shall be electrically actuated, power open-fail close type, UL 555 and UL 555S classified for 1-1/2 hours.
- E. Provide a service disconnect switch for each and every combination smoke and fire damper.

3.13 DETECTORS

- A. Smoke detectors shall be installed in accordance with requirements of the California Mechanical Code.
- B. Smoke detectors shall be installed in systems of over 2000 CFM capacity to detect presence of smoke and automatically shut down air handling units or fans unless it has been verified with the electrical installer that Exception 1 to CMC 609.0: Automatic Shutoffs, regarding automatic shutdown of systems with total coverage smoke detection systems is applied.
- C. Smoke detectors shall be installed in supply system downstream of filters.

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3.14 BACKDRAFT DAMPERS

- A. Backdraft dampers shall be installed at locations indicated in accordance with the State of California Building Energy Efficiency Standards, Title 24, CCR.

3.15 DUCT SLEEVES AND PREPARED OPENINGS

- A. Furnish duct sleeves for 15-inch diameter ducts or less passing through floors, walls, ceilings, or roof and install during construction of the floor, wall, ceiling, or roof. Install round ducts larger than 15 inches diameter and square and rectangular ducts passing through floors, walls, ceilings or roof through prepared openings. Provide duct sleeves and prepared openings for duct mains and duct branches.
- B. Provide one inch clearance between duct and sleeve or between insulation and sleeves for insulated ducts, except at grilles, registers and diffusers.
- C. Provide prepared openings for round ducts larger than 15 inches in diameter and for square and rectangular ducts with one inch clearance between duct and openings or between insulation and opening for insulated ducts, except at grilles, registers and diffusers.
- D. Provide closure collar of galvanized sheet metal not less than 4 inches wide unless otherwise indicated on Drawings on each side of walls or floors where sleeves or prepared openings are provided except where grilles or diffusers are installed. Install collar tight against surface. Fit sharp edges of collar installed around insulated duct to preclude tearing or puncturing insulation covering vapor barrier. Fabricate collars from round ducts in steel. Provide not less than 4 nails to attach collar where openings are 12 inches in diameter or less and not less than 8 nails where openings are 20 inches in diameter or less.
- E. Pack space between sleeve or opening and duct or duct insulation with commercial grade packing yarn.

3.16 FLEXIBLE DUCT RUNOUTS

- A. Runouts from branches, risers or mains to air terminal units and outlets may be pre-insulated, factory fabricated flexible ducts complying with NFPA 90A. Flexible ductwork shall not exceed 7 feet in length. When required to suspend flexible ducts, furnish hangers of type recommended by manufacturers of pre-insulated flexible duct and install at intervals recommended. Method of attachment to other components of air distribution system for a vapor-tight joint shall be in accordance with printed instructions of flexible duct manufacturer. Bend radius shall be 1-1/2 times diameter of duct, measured from centerline. Bends greater than 90-degree angle are not permitted. Non-metallic flexible duct shall be permitted only in T-bar suspended ceilings.

3.17 DUCT HANGERS AND SUPPORTS

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- A. Exposed or easily accessible ductwork: All exposed ducts shall be supported by all-thread Rod as a single hanger and or a trapeze support for rectangular duct work in accordance with requirements of the latest edition of the HVAC Duct Construction Standards – Metal and Flexible of SMACNA.
- B. Non-accessible ductwork: Non-exposed and hidden from sight during regular school operations ductwork, rigid round, rectangular, and flat oval metal ducts, shall be installed with support systems conforming to SMACNA Standards.
- C. Where ducts are installed one above the other, they shall be individually supported on a trapeze of steel angles with 3/8 inch supporting steel rods securely fastened to overhead construction. A minimum distance of 3 inches shall be maintained between ducts wherever possible, but in no event shall distance be less than 2 inches. Minimum sizes of steel angles shall be 1 ½-inch by 1 ½-inch by 1/8 inch for duct sizes through 60 inches in greatest dimension, 2-inch by 2-inch by 1/8 inch for duct sizes 61 inches through 84 inches, 2-inch by 2-inch by 3/16 inch for duct sizes 85 inches through 96 inches, and 2-inch by 2-inch by 1/4 inch for duct sizes over 97 inches.
- D. Ducts six square feet area and greater and or minimum 28” round or greater shall be seismically restrained. Refer to Section 23 0548: HVAC Sound, Vibration and Seismic Control.
- E. Hangers shall not be supported by, or fastened to, non-structural members including blocking. Toggle or Molly type bolts are not permitted.
- F. Vertical ducts shall be supported with suitable angles on each side of each duct located at each floor and at intervals not to exceed 8 feet. Angles shall be sized and installed according to SMACNA Standards for required span so that they will be rigid, without bending or sagging.
- G. Roof-mounted ductwork shall be installed a minimum 12 inches above roof and shall be supported by galvanized welded pipe, one on each side, fastened to roof structure, flashed and sealed to roof membrane. Install supports at each turn, unit connections, and each penetration, and space at maximum 6 feet off-center in general. Pitch pockets are not allowed.

3.18 ACCESS PLATES AND DOORS

- A. Access plates and doors shall be furnished and installed where stops, valves, fire dampers, fusible links, coils, damper operating mechanism, control equipment, lubrication fittings, air filters, air handling equipment and similar items normally requiring adjustment or servicing are installed in concealed spaces.
- B. Access plates and doors shall be located to permit convenient access to equipment sized to permit removal of equipment for servicing. Access plates shall be no less than 12-inch by 12-inch in clear opening. Proper servicing of equipment requires adequate access for maintenance personnel. Access doors shall not be less than 24-inches by 24-inch, unless otherwise detailed. Two or more valves shall not be located in same

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access area unless sufficient clearance is provided for operation, servicing and removal of each valve.

- C. Openings in ducts or plenums whose longer dimension does not exceed 12 inches may be covered by a plate of same material as duct, gasketed and fastened to duct or plenum with sheet metal screws.
- D. Access plates in floors shall not be less than 8-inch by 8-inch and shall be carborundum surface brass with cast brass frames anchored into concrete. Access plates in tile walls shall be chromium plated brass and polished. Serrated plates furnished as part of a clean-out assembly are permitted in floors instead of a separate plate.
- E. Access plates and doors in walls and ceilings of finished rooms and in locations normally accessible to students shall be furnished with continuous piano hinges, unless otherwise specified, and a special flush type spring-loaded latch requiring an Allen wrench to operate. Access devices shall be installed after plastering in plaster ground openings.
- F. Access panels or doors penetrating one-hour fire resistive ceilings shall meet code requirements for such openings.
- G. Access panels shall be fire-rated; Milcor, or equal. Access doors shall be as required for installation in openings penetrating one-hour fire resistive ceilings. Access doors shall be furnished with a flush, key-operated cylinder lock, furnished with two keys each, instead of Allen headlock for non-rated ceilings.
- H. Access panels that are part of an integrated ceiling are specified in Section 09 8433: Cementitious Wood Fiber Acoustical Units. Identification markers shall be affixed to adjacent supports, under this portion of Work, to indicate location and type of mechanical device to be serviced.
- I. Access panels installed in ducts or plenums located in heater or equipment rooms containing gas-fired equipment shall be furnished with heavy-duty spring closing hinges and refrigerator door type catches unless otherwise required. When these panels are intended for maintenance personnel access, catches shall be operable from both interior and exterior.
- J. Other access panels, except those specified above, shall be furnished with suitable hinges and one or more sash fasteners.
- K. Panels located in ducts and plenums shall be installed with gaskets made of synthetic rubber, felt, or similar material to provide an airtight installation. Panels shall be constructed and reinforced to prevent vibration.
- L. Label the words "FIRE DAMPERS" on panels over fire dampers and words "DO NOT OPEN - HEATER IS OPERATING" on panels located in heater or equipment rooms. Letters shall be approximately 3 inches high, if space is available.

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- M. Furnish a key to operate latch access plates, one for each access plate, but not to exceed five keys for any one Project.
- N. Access plates and panels shall be furnished with manufacturer's name or trademark and model number cast or stamped thereon, or upon a label permanently affixed thereon.
- O. Provide duct through roof flashing as detailed in the SMACNA standards or as indicated on Drawings.
- P. Refer to SMACNA for access plate and door construction.

3.19 CLEANUP

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

3.20 PROTECTION

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

END OF SECTION

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SECTION 23 38 13 - KITCHEN VENTILATION SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Kitchen ventilation system. Including, but are not limited to:

1. Make-up Air Unit with Heating and Cooling.
2. Exhaust Fan.
3. Ductwork and Appurtenances.
4. Controls.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 26: Electrical.
3. Section 22 1000: Plumbing.
4. Section 23 0500: Common Work Results for HVAC.
5. Section 23 0513: Basic HVAC Materials and Methods.
6. Section 23 0548: HVAC Sound, Vibration and Seismic Control.
7. Section 23 3000: Air Distribution.
8. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 SYSTEM DESCRIPTION

A. Kitchen ventilation system shall provide heating, ventilating and cooling to prevent extreme temperatures in the kitchen. Kitchen temperature shall be controlled by room thermostat. Supply air fan shall automatically shut off when kitchen fire alarm is activated.

1.03 SUBMITTALS

A. Provide in accordance with Division 01 and Section 23 0500: Common Work Results for HVAC.

B. Manufacturer's Data:

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1. Complete list of items to be furnished and installed under this Section.
 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements, three sets of operation and maintenance manuals, and service, parts list, and installation instructions.
- C. Shop Drawings:
1. Submit Shop Drawings and layout drawings of complete kitchen ventilation system, including, but not limited to, dimensioned location of exhaust hood, exhaust fan, heating, ventilating, cooling, make-up air unit, and ductwork.
 2. Provide Drawings for the kitchen ventilation system in accordance with requirements of NFPA 96.
- D. Closeout Submittals: Submit Project Record Documents and Operations and Maintenance Manuals in accordance with Section 23 0500: Common Work Results for HVAC.
- 1.04 QUALITY ASSURANCE
- A. Standards: Kitchen ventilation system fabrication and installation shall comply with NFPA 96 standards, applicable provisions of Section 23 0500: Common Work Results for HVAC, and the California Mechanical Code (CMC).
 - B. Qualifications of Manufacturers: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a minimum of 5-year history of successful production.
 - C. Qualification of Installers: Provide adequate number of skilled workmen, thoroughly trained and experienced in necessary crafts, and completely familiar with specified requirements and methods needed for proper performance of the Work of this Section.
- 1.05 INSTRUCTIONS
- A. Prior to Substantial Completion, provide a 2 hour instruction period on system and equipment operation and maintenance procedure before or during completion test, in compliance with Section 23 0500: Common Work Results for HVAC, to designated Owner personnel. Coordinate and arrange for instruction period.
 - B. Instructions shall be provided by an individual who has been thoroughly trained and experienced to demonstrate proper operation and maintenance procedure of particular system and equipment.
- 1.06 PRODUCT HANDLING
- A. Comply with provisions stated under Section 23 0500: Common Work Results for HVAC.
- 1.07 COORDINATION

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- A. Coordinate activities in accordance with provisions of Section 01 3113: Project Coordination.

PART 2 – PRODUCTS

2.01 KITCHEN HOOD DUCTWORK

- A. Make-up air supply and exhaust duct connections for kitchen hood shall be furnished in parallel configuration only. Exhaust duct shall have a minimum velocity of 1,500 fpm and a maximum velocity of 2,100 fpm. Exhaust duct shall be constructed of stainless steel Type 304, 18 gage minimum with welded joints. Make-up supply ductwork shall be constructed of stainless steel Type 304, 18 gage minimum with welded joints on parallel duct arrangement. Duct installation shall conform to NFPA 96. Exhaust duct connecting collars shall be of heat expansion type. Field weld exhaust duct to mating flange at canopy, in accordance with CMC requirements. Factory fabricated ductwork, when approved, shall be furnished by duct manufacturer and shall be UL listed as grease duct for restaurant cooking appliances.
- B. Clean-outs and other openings: Refer to CMC requirements.
- C. Duct enclosure: Refer to CMC requirements.
- D. Prevention of grease accumulation: Refer to CMC requirements.
- E. Other requirements of CMC and Section 23 3000: Air Distribution.

2.02 KITCHEN HOOD EXHAUST FANS (KEF)

- A. Exhaust fan shall be roof-mounted, upblast, direct-drive type, complete with centrifugal backward inclined blades, UL listed for removal of smoke and grease laden air. Unit shall be rated for continuous service at 300 degrees F conforming to UL 762 and shall be rated in accordance with ANSI/AMCA 210. Unit shall be compatible for installation with kitchen hood specified. Utility type fans may be furnished where building configuration does not permit the installation of upblast roof exhausters.
- B. Unit shall be Captiveaire, Loren Cook Company, Greenheck, or Supreme Fan, or equal.

2.03 KITCHEN MAKE-UP AIR UNIT (MAU)

- A. Make-up air unit shall be roof mounted type factory built-up assembled and wired in accordance with NFPA 70: NEC and ETL listed to ANSI Z83.8 and CSA 2.6 standards as a package. The energy usage shall be designed to meet ANSI/ASHRAE Standard 90.1
- B. The unit shall be Captiveaire, or equal, and shall be furnished with the following:
 - 1. Plenum fan, permanently lubricated bearings, direct drive. Motor and blower shall be rubber in shear vibration isolated.

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2. Disposable media type air filters 2 inches thick of MERV 13 efficiency, shall be provided in the air stream, unless indicated otherwise in the drawings.
3. Outside air shall enter unit through an outside air hood with moisture elimination louvers and bird screen or evaporative cooler with 1" pre-filter unless otherwise indicated on the Drawings.
4. Cabinet shall have through-the-base utility knockouts. Control service compartment doors shall be hinged. Blower door hardware shall be heavy duty stainless. Control and burner door hardware shall be heavy duty external hardware. Unit cabinet shall be supplied with double wall steel construction with factory installed 1 ½ pound density insulation. R value of insulation shall be 3.8 or greater. Insulation with foil backing is not acceptable. The packaged system shall have a pre-coat RAL 1001 white paint finish. Finish shall be a minimum 60 gloss on G90 galvanized steel. Painted metal shall pass 1,000 hour salt spray test per ASTM B117. Unit shall be designed with heavy 16 gage pre-painted steel rail perimeter base. Base shall feature provisions for corner lifting, with lifting strap holes to facilitate handling and installation.
5. Cooling of outside air shall be provided by DX cooling.
 - a. For cooling, unit shall be provided with a DX split system. Manufacturer shall provide a factory-installed cooling coil in a cabinet. Manufacturer shall also provide an integral condensing unit section for DX cooling. Unit shall use non-ozone depleting R-410a refrigerant. Units 7.5 tons and above shall have dual circuits with independent scroll compressors. Dual circuits shall have independent liquid line receivers.
 - 1) Evaporator coils:
 - a) Aluminum plate fins mechanically bonded to enhanced copper tubes with joints brazed.
 - b) Tube sheet openings shall be belled to prevent tube wear.
 - c) Evaporator coil shall be of full-face active design.
 - d) Dual circuit models shall have face-split type evaporator coil.
 - 2) Condenser coils Type A, B or C are acceptable.
 - a) Type A: Copper-tube, aluminum-fin coil, with liquid subcooler. Internally enhanced 3/8 inch OD seamless copper tubing mechanically bonded to aluminum fins.
 - b) Type B: Spine Fin™ condenser coil shall be continuously wrapped, corrosion resistant aluminum

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with minimum brazed joints. This coil is 3/8 inch OD seamless aluminum tubing glued to a continuous aluminum fin. Coils are lab tested to withstand 2,000 pounds of pressure per square inch. The outdoor coil provides low airflow resistance and efficient heat transfer. The coil is protected on four sides by louvered panels.

- c) Type-C: Coil shall be air-cooled Micro-Channel heat exchanger technology (MCHX) and shall have a series of flat tubes containing a series of multiple, parallel flow microchannels layered between the refrigerant manifolds. Coils shall consist of a two-pass arrangement. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds in combination with a factory applied corrosion-resistant coating.
- C. Unit shall be supplied from factory with EPA compliant premium efficiency ODP blower motor and factory installed VFD.
- D. Unit shall be provided with a remote control panel that will provide the control functions that are indicated on the drawings including but not limited to the following:
 - a. Thermostat for space temperature control.
 - b. Fan on/off and speed indicator lights.
 - c. Manual on/off switch.
- E. Make up air unit shall be provided with an automatic cut-off through a field furnished detector in the event of fire.
- F. Electrical wiring, components and connections including electrical grounding shall be made in accordance with the National Electrical Code (NFPA 70). A separate line voltage supply shall be run directly from the main panel to a fused disconnect switch, at the unit, and then making connection to leads in the unit junction box. External wiring shall be made within approved conduit and shall have a minimum temperature rise rating of 60 degrees C. The unit shall be electrically grounded in accordance with the National Electrical Code (NFPA 70) when installed if an external source is utilized. Units shall be equipped with a 24 volt control transformer; protective air proving switch; resiliently isolated venter motor and a high temperature limit control. Operation shall be controlled through an integrated circuit board. The circuit board shall monitor heater operation and have LED diagnostic lights to identify abnormalities in control functions.

PART 3 – EXECUTION

3.01 EXAMINATION

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3361-008-000

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- A. Examine areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Kitchen ventilation system shall be installed in accordance with manufacturer's instructions and shall comply with NFPA 96 and CMC.
- B. Exterior surfaces of roof-mounted equipment shall be weatherproofed.

3.03 COMPLETION TEST

- A. Project Inspector shall be notified 48 hours in advance of testing. Notify fire authorities and test components of system and sequence of operation in presence of and for observation of the Project Inspector and fire inspectors.

3.04 CLEANUP

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

3.05 PROTECTION

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

END OF SECTION

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SECTION 23 70 00 – AIR HANDLING UNITS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Indoor air handling units.

B. Related Requirements:

1. Division 01: General Requirements.
2. Section 23 0500: Common Work Results for HVAC.
3. Section 23 0513: Basic HVAC Materials and Methods.
4. Section 23 0548: HVAC Sound, Vibration and Seismic Control.
5. Section 23 0700: HVAC Insulation.
6. Section 23 0900: HVAC Instrumentation and Controls.
7. Section 23 8000: Heating, Ventilating and Air Conditioning Equipment.

1.02 REFERENCES

A. Air Movement and Control Association International, Inc. (AMCA):

1. AMCA 211 – Certified Ratings Program - Product Rating Manual for Fan Air Performance.
2. AMCA 300 – Reverberant Room Method for Sound Testing of Fans.
3. AMCA 301 – Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

B. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):

1. AHRI 410 – Forced Circulation Air-Cooling and Air-Heating Coils.

C. American Society for Testing and Materials International (ASTM):

1. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
2. ASTM D2247 – Standard Practice for Testing Water Resistance of Coatings in 100 Percent Relative Humidity.

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- 3. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. National Fire Protection Association (NFPA):
 - 1. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.
- E. Underwriters Laboratories, Inc. (UL):
 - 1. UL 181 – Standard for Factory-Made Air Ducts and Air Connectors.
 - 2. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.
 - 3. UL 1995 –Heating and Cooling Equipment.
- F. Underwriters Laboratories of Canada (ULC):
 - 1. CAN/ULC-S102.2 – Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.
- G. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
 - 1. ASHRAE Standard 62.1 – Ventilation for Acceptable Indoor Air Quality.
- H. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA – MG 1, Table 12-10: NEMA Threshold Full-Load Nominal Efficiency Values for Energy-Efficient Motors.

1.03 SUBMITTALS

- A. Comply with provisions of Division 01 and Section 23 05 00: Common Work Results for HVAC.
- B. Manufacturer's Data:
 - 1. Complete materials list of items proposed to be furnished and installed under this Section. Materials lists, which do not require performance data, shall include manufacturer's name, type, and model number for indicated installation.
 - 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements. Literature shall include descriptions of equipment, types, models and sizes proposed, capacity tables or curves marked to indicate performance characteristics, electrical requirements, options selected, space requirements and other data

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necessary to ensure compliance with requirements of this Specification and performances indicated on Drawings.

3. Provide data of filter media, filter performance data, filter assembly, and filter frames.
- C. Shop Drawings indicating methods of installation of equipment and materials, and details of supporting structures for items indicated. Items to be submitted shall include but not be limited to the following:
1. Layout Drawings of Equipment: Include plans, elevations, and sections, of proposed equipment drawn to scale, to establish which equipment shall fit in allotted spaces with clearance for installation and maintenance. Indicate proposed details for attachment. Indicate vibration isolation units, foundations, supports, and openings for passage of pipes and ducts.
 2. Electrical interlock or control diagrams for electrically controlled components furnishing more than one automatic or manual control devices, which are not indicated on Drawings.
- D. Manufacturer's Recommended Installation Procedures: Manufacturer's recommended installation procedures, when reviewed by the Architect shall become basis for inspecting actual installation procedures provided.
- E. Acoustical Test Report: Submit complete acoustical test reports showing that proposed products have been tested in accordance with latest versions of AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans, and AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- F. Submit test certification stating compliance with the maximum requirement of 1 percent cabinet leakage of the specified airflow.
- G. Operations and Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts list and wiring diagrams.

1.04 QUALITY ASSURANCE

- A. Qualifications of Manufacturers and Installers: Comply with provisions in Section 23 05 00: Common Work Results for HVAC.
- B. Sound Level Measurements and Calculations:
1. Sound power level measurements and calculations shall be made in complete accordance with latest version of AMCA Standard 300, Methods for Calculating Fan Sound Ratings from Laboratory Test Data, and AMCA Standard 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 2. The results of all testing shall be certified by independent testing agency or an AMCA-approved testing laboratory and submitted to architect for

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approval. The submittal shall include a complete description of test conditions, methods and procedures, including specific installation type used for measurements, as detailed in AMCA 300.

- 3. Maximum Allowable Sound Power Levels: Maximum allowable sound power levels for supply discharge, return intake, and casing radiated noise shall not exceed values given in schedule below as indicated on drawings with equipment operating at design airflow and static pressure conditions.

 - C. Factory Leak Testing: Manufacturer shall provide a factory leak test on units at design total static pressure across the cabinet exterior walls. Cabinet leakage shall not exceed 1 percent of specified airflow on the operating side of the unit. All panels shall be sealed with closed cell gasketing material. A written test report shall be prepared by the manufacturer and submitted to the Architect.
- 1.05 PROJECT RECORD DOCUMENTS
- A. Provide Owner instructions on equipment operation and maintenance procedures, as indicated in Section 23 05 00: Common Work Results for HVAC.
- 1.06 PRODUCT HANDLING
- A. Protection, Replacements, Delivery and Storage: Comply with provisions stated under Section 23 05 00: Common Work Results for HVAC.

PART 2 – PRODUCTS

2.01 CUSTOM INDOOR CENTRAL STATION AIR HANDLING UNIT:

- A. General:
 - 1. Central station air-handling unit specially designed, fabricated and factory tested for the capacity, configuration, arrangement and components as indicated on Drawings.
 - 2. Units shall be UL or ETL approved to ensure compliance with electrical codes.
 - 3. Unit shall be serviceable through service clearances indicated on drawings.
 - 4. Unit dimensions shall not exceed dimensions indicated on drawings.

- B. Base Frame: Provide a full perimeter welded base frame capable of mounting to a curb and supporting unit during shipment, installation, and operation. Base frame shall be manufactured with structural steel tubing or C-Channel support members. Formed metal base rails with bolted or screwed support members are not acceptable. Base and unit frame shall be painted with a gray phenolic, corrosion inhibitive primer. Base rails shall be fitted with lifting lugs at corner of

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unit or section (if demounted). Base rail shall overhang curb to facilitate water run-off and protection of curb-to-base connection from water intrusion. Base shall include a formed pocket that seats on roof curb gasketing to provide a positive, weather-tight seal.

- C. Base: The base shall include 2-inch foam insulation or a 4-inch thick fiberglass insulated "double bottom" floor with minimum 20 gage G-90 galvanized outer and 14 gage G-90 galvanized inner walk-on surface. Subfloor is not required with 2-inch foam insulation unless the underfloor is being used as a return air plenum. All floor seams shall be sealed for an airtight unit. Where access is provided to unit interior, floor openings shall be covered with walk on steel safety grating. Single wall floors with glued and pinned insulation are not acceptable. Base frame shall be attached to unit at factory.
- D. Casing:
1. Sections of unit shall be of same construction and finish except for interior panels that are specified differently for individual sections.
 2. Exterior Panels: Exterior panels including cooling coil sections shall be minimum 2-inch thick formed 16 gage galvanized steel. Provide necessary support to limit casing deflection to 1/200 of narrowest panel dimension. If panels cannot meet this deflection, add additional internal reinforcing. Panel seams shall be fully welded or sealed for an airtight unit. Leakage rates shall be less than 1 percent at design static pressure. The exterior panel finish shall have a polyurethane paint system that is designed for long term corrosion resistance meeting or exceeding ASTM B117, Salt Spray Resistance, at 95 degrees F, 1,000 hrs. and ASTM D2247, Humidity Resistance, at 95 degrees F, 1,000 hrs. The color shall be sterling gray.
 3. Interior Panels: Casing shall be of double wall construction with 20 gage interior galvanized steel liner in all sections and 22 gage galvanized steel perforated liner in all fan sections.
 4. Insulation: Casing shall have 2-inch minimum thickness foam injected R-13 insulation.
 5. Thermal Breaks: Casing construction downstream of the cooling coil shall consist of thermal break panels to prevent condensation from accumulating on outer walls
 6. Access doors shall be of double wall construction and shall be installed on stainless steel hinges for outward opening applications. Multiple handles of no more than four, shall be provided to assure positive closure. Handles shall be zinc alloy or glass reinforced nylon and rated to meet 500 hour salt-spray requirements. Doors shall be furnished with 2 seals with an atmospheric break between two seals to ensure zero negative pressure. The outer seal shall shield water from inner seal. Doors shall open outward for negative pressure and inward for positive

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pressure applications. Operating pressure of unit shall ensure that door compresses gasket seal. Doors shall open against system pressure. Provide ETL, UL, and CAL/OSHA approved tool operated safety latch on all fan section access doors. Access doors downstream of the cooling coil shall be thermal break.

7. Floors shall be double wall. Insulation shall be capped to isolate floor insulation from both airstream and from potential water damage.
8. Units shall be provided with exterior paint.
9. Unit shall provide an integral base which is capable of curb, platform or pad mounting and supporting unit during shipment, installation, and operation.

E. Fan Section:

1. General: Fan section shall be furnished with a structural steel base for integral mounting of fan assembly and casing panels. Fan scroll, wheel, shaft, bearings, drives, and motor shall be installed on a structural steel base frame assembly isolated from outer casing with factory-installed, spring isolators of deflection indicated on drawings. This base frame assembly shall be seismically braced. Flexible connectors shall be provided between fans and stationary part of unit. Wiring shall be in flexible conduit. Comply with Section 23 0548: HVAC Sound, Vibration and Seismic Control. Hinged access door, as specified above, shall be provided on both sides of unit.
2. Fans: Each unit shall be furnished with one or more supply fans as required. Fans shall be double-width, double-inlet type with backward curved airfoil blades or shall be single width, single inlet, ARR. 1 or ARR. 4 plug type fans with backward curved airfoil blades as indicated on equipment schedule. Fans shall be AMCA Class II rated.
3. Fan Bearings: Bearings shall be selected for a minimum L10 life (200,000 hours) at maximum horsepower and operating speed for classification. Bearings shall have same bore, type and manufacturer. Rigid support for inlet bearing must be removable for access to wheel.
4. Fan Wheels: Fan wheels shall be painted with zinc chromate primer and an enamel finish coat, unless constructed of aluminum. Fan wheels shall be keyed to shaft and shall be designed for continuous operation at maximum rated fan speed and motor horsepower. Fan wheels and shafts shall be selected to operate at 25 percent below first critical speed, and shall be statically and dynamically balanced as an assembly at factory.
5. Fan shafts: Fan shafts shall be solid steel, turned, ground, polished, and coated with rust-preventive oil. Access doors shall be provided so fan shaft may be removed without removal of casing panels and to facilitate air balancing of system.

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6. Fan Motor: The motor shall be installed within fan section casing on adjustable slide rails. Motor shall be open drip-proof, NEMA Design B with size and electrical characteristics as indicated on equipment schedule. Motors shall be mounted on a horizontal flat surface and shall not be supported by fan or its structural members. Each motor shall be tested to IEEE Standard 112, test method B, and NEMA MG 1 Article 12.58.2 and 12.59 Table 12-10 and bear a factory certification run test label to verify compliance. Motors shall be premium efficiency, inverter duty, with minimum 90 percent efficiency for motors greater than 3 horsepower.
7. Fan Drives: Fan drive shall be designed for a minimum 1.3 service factor, shall be constant-speed variable pitch for motors 15 hp or less, and shall be constant-speed fixed-pitch for 20 hp and larger. Drives shall be factory mounted, with belts aligned and tensioned.
8. Fan Sound Ratings: Fans shall be AMCA 211 rated for performance and AMCA 300 and 301 rated for sound.
9. Accessories: The fan section shall be furnished with double pane glass viewport with safety wire reinforcement, field wired service light with safety cage and extended lubrication lines to unit exterior for fan motor and fan bearings

F. Coil Section:

1. General: Coil sections shall be fabricated of insulated galvanized steel panels. Coils shall be easily removable from side of units. Where 2 or more coils are installed in a coil bank, 304 stainless steel intermediate drain pans that extend a minimum of 6 inches from coil face shall be provided and condensate shall be piped to bottom drain pan. The bottom coil shall not serve as a drain path for upper coil. Main drain pan shall be insulated double-wall 304 stainless steel, sloped toward drain fitting. Drain fitting shall be flush with bottom pan for side discharge, FPT 304 stainless steel connection and shall comply with ASHRAE Standard 62 recommendations. A maximum of one drain shall be furnished for each cooling coil section. Moisture shall not carry over past coil.
2. Coil Test and Standards: Coils shall be leak tested at 450 psig air pressure while submerged in water. Coil performance shall be certified in accordance with AHRI Standard 410. Coils shall be furnished with galvanized steel casing as standard.
3. Coil Tubes: Tube wall thickness shall not be less than 0.02 inch. Tube diameter with 0.025 inch brazed return bends on water and refrigerant coils. Tubes shall be 5/8 inch OD to ensure high thermal performance with lower total flow and reduced pumping requirements. Intermediate tube support shall be provided for coils over 44-inch fin length with an additional support every 42 inches.

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- a. Coil options shall be furnished with aluminum fin construction.

G. Filter Section:

1. General: Each filter section shall be designed and constructed to house specific type of filter indicated on equipment schedule. Provide filters of type indicated on schedule. A double-walled hinged access door, as specified above, shall be provided on side of section. Internal blank-offs shall be provided to prevent air bypass around filters.
2. Filter tracks in flat or cartridge filter sections: Filter tracks in flat or cartridge filter sections shall be upstream loaded Type 8 constructed from galvanized steel to ensure rigidity and tight tolerances. Tracks must be field adjustable without tools and designed to accept standard-size filters with one inch, 2-inch, or 4-inch widths.
3. Filter tracks in angle filter sections: Filter tracks in angle filter sections shall be constructed from galvanized steel to ensure rigidity and tight tolerances. Angle filter sections shall be designed to hold 2-inch filters of standard sizes, arranged in horizontal V-formation.
4. Each filter bank shall be provided with a Dwyer Series 2000 Magnehelic Differential Pressure Gage, or equal.
6. Mixing boxes or Economizer Section: Combination exhaust mixing boxes and filter-mixing boxes shall be furnished with opposed blades, interconnecting outside-air and return-air low leak dampers. Mixing boxes and filter-mixing boxes shall be furnished with a double-walled hinged access door as specified. Floors of 16 gage galvanized steel shall be furnished for mixing boxes to protect insulation during installation and servicing of damper actuators. Non-ducted outside air intakes shall include stationary louvers to reduce opportunity for rain or snow to enter unit.

H. Damper Section:

1. Face and bypass sections shall be furnished with opposed-acting damper blades in face damper and opposed bypass damper. Blades shall be double-skin airfoil type.
2. Damper blades shall be extruded aluminum, housed in a galvanized steel frame and mechanically fastened to a hex axle rod rotating in stainless steel bearings. Dampers shall be sectionalized to limit blade length to no more than 48 inches so as to minimize blade warpage. Replaceable neoprene blade seals are to be provided to insure tight closure.
3. Dampers shall be rated for maximum leakage rate per square foot of 7 cf. at 1.0 inch wg. Optional premium dampers shall be available for maximum leakage rate per square foot of 5 cfm at 1.0 inch wg. Damper

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blades shall be double-skin extruded aluminum airfoil type with stainless steel jam seals.

I. Plenum Sections:

1. General: Inlet, discharge, access, and plenum sections shall be installed where indicated on Drawings and shall be as specified on equipment schedule.
2. Inlet section: Inlet section shall be provided with extruded aluminum stationary louvers. Louvers shall be drainable type with built in downspouts and furnished with birdscreen. Blades shall be vertical and housed inside an aluminum frame and mounted to unit exterior. Louvers shall be painted to match unit exterior.
3. Access sections: Access sections shall be provided by a double-walled hinged door, as specified above and 16 gage galvanized steel floors to protect insulation.
4. Downblast discharge section: Downblast discharge section, which provides an opening through roof, shall be furnished with a grating over duct opening of sufficient size and strength to support a minimum of 300 pounds.
5. Diffuser sections: Diffuser sections shall consist of casings as specified with an integral perforated aluminum plate installed on discharge side of supply fan to ensure even and uniform air distribution over adjacent downstream component. Not required on plug fan applications.
 - a. Blow-thru coil sections shall be provided with diffuser as an integral part of coil section and shall not extend length of standard section.
 - b. Diffuser sections shall be available and required if a filter section is directly following fan.
 - c. Unit panels shall be constructed of 16 gage galvanized steel.
 - d. A hinged access door shall be provided down-stream of mixer if specified. It shall be full height, insulated double-wall, with full perimeter gasketing.
 - e. Unit shall mix two or more air streams of different temperatures to within a range of six degrees F standard deviation of theoretical mixed-air temperature and shall provide a more uniform air velocity contour entering a downstream filter or coil bank.

J. Sound Attenuators: Sound attenuators as specified in Section 23 0548 shall be provided as an integral part of unit when specified or indicated on drawings.

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- K. Electrical: Provide electrical and automatic control devices that are listed below and on drawings:
1. The units shall be factory pre-wired for a single point electrical power connection for both power and control circuits. Manufacturer shall provide a factory furnished and wired step down transformer with a fused disconnect for 120 Volt service.
 2. Provide a main disconnect for each unit.
 3. Each fan motor shall be wired to a non-fusible disconnect.
 4. The unit shall be equipped with vapor proof light fixtures with guard.
 5. Lights shall be controlled by one light switch mounted adjacent to supply air fan access door. Lights shall be provided in each accessible section.
 6. Furnish a 120 Volt duplex convenience outlet on exterior of unit. Locate outlet next to fan section access door.
 7. A separate Variable Frequency Drive and three contactor bypass is required for each motor in unit including factory mounting and wired to motor. Danfoss, ABB, Toshiba, or equal.
 8. VFDs shall be recessed or surface mounted as shown on the drawings.
- L. Acoustical Performance Requirements: The sound generating characteristics of air handling and multi-zone units shall be tested to, and comply with, all requirements of this specification. Representative samples shall be subjected to tests in accordance with applicable standards and procedures in order to demonstrate such compliance. A special test for this project is not required if manufacturer has previous certified test results that can be made applicable to this project.
- M. Manufacturer: Trane, or equal.

PART 3 – EXECUTION

3.01 GENERAL

- A. Examine areas under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

3.02 EQUIPMENT FOUNDATIONS

- A. Equipment foundations shall be of sufficient size and weight, and of proper design to preclude shifting of equipment under operating conditions, or under any abnormal conditions imposed upon equipment.

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- B. Foundations shall meet requirements of equipment manufacturer and, when required by the Architect, obtain from equipment manufacturer, approval of foundation design and construction for equipment to be installed. Equipment vibration shall be maintained within design limits, and shall be dampened and isolated. Isolators shall be bolted to a steel member so as to be readily removable.

3.03 EQUIPMENT INSTALLATION

- A. Equipment Installation: Equipment installation shall be in strict accordance with these Specifications, and installation instructions of manufacturers. Equipment installed on concrete foundations shall be grouted before piping is installed. Piping shall be installed in such a manner as not to place a strain on any of the equipment. Flanged joints shall be adequately extended before installation.
 - 1. Install equipment in a neat and skillful manner, properly aligned, leveled, and adjusted for satisfactory operation.
 - 2. Install so connecting and disconnecting of piping and accessories can be readily accomplished, parts are readily accessible for inspection, service and repair. Space shall be provided to readily remove filters, coils, and fan wheels.

3.04 NOISE AND VIBRATION

- A. Operation of Equipment: Mechanical equipment and piping systems shall operate without exceeding specified noise and/or vibration levels.
- B. Corrective Measures: If specified noise and/or vibration levels are exceeded, provide necessary changes to reduce noise and/or vibration levels to within specified levels.

3.05 FIELD TESTS AND INSPECTION

- A. General: Perform field inspections, field tests, and trial operations as specified in Section 23 0500: Common Work Results for HVAC. Provide labor, equipment and incidentals required for testing. The Project Inspector will witness field tests and trial operations as specified in Section 23 0500: Common Work Results for HVAC.
- B. Equipment and Material: Equipment and material certified as being successfully tested by manufacturer, in accordance with referenced Specifications and standards, will not require re-testing before installation. Equipment and materials not tested at the place of manufacture will be tested before or after installation, as applicable or necessary, to determine compliance with reference Specifications and standards.
- C. Start-Up and Operational Test: System shall be started up and initially operated with components operating. During this test, filters shall be periodically cleaned until no further accumulation of foreign material occurs. Adjust safety and automatic control instruments as required to provide proper operation and control sequence. Refer to Section 23 0500: Common Work Results for HVAC.

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- D. Extent of Field Tests: After installation and before completion, Work of this Section shall be subjected to required field tests, including those specified here and in Section 23 0500: Common Work Results for HVAC.
- E. Operation and Maintenance Data: Provide required operation and maintenance data as specified in Section 23 0500: Common Work Results for HVAC.

3.06 PROTECTION

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

3.07 CLEANUP

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

END OF SECTION

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SECTION 23 80 00 - HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: Air conditioning and air handling equipment including but not limited to:
 - 1. Fans.
 - 2. Package Roof Top Air Conditioning Units.
- B. Related Requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 07 60 00: Flashing and Sheet Metal.
 - 3. Section 22 10 00: Plumbing.
 - 4. Section 23 05 00: Common Work Results for HVAC.
 - 5. Section 23 05 13: Basic HVAC Materials and Methods.
 - 6. Section 23 05 48: HVAC Sound, Vibration and Seismic Control.
 - 7. Section 23 09 00: HVAC Instrumentation and Controls.
 - 8. Section 23 09 23: Environmental Control and Energy Management System.
 - 9. Section 23 30 00: Air Distribution.

1.02 DESIGN REQUIREMENTS

- A. Work of this Section is based on HVAC equipment units indicated as Basis of Design in Part 2 of this Section. Products from different HVAC equipment manufacturers listed are never identical, although equivalent in capacity, performance and quality. In the cases where dimensions, weight, configuration and utility requirements differ from the products used as a basis of design, the Contractor, at no additional cost to the Owner, shall coordinate and submit, for Architect review, revisions to the design.

1.03 SUBMITTALS

- A. Provide in accordance with Division 01 and Section 23 05 00: Common Work Results for HVAC.

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- B. For products listed that are not the basis of design, submit the following in addition to above requirements:
 - 1. Title 24 Calculations: Replace HVAC unit values in calculation files provided by the Architect and submit for review.

1.04 QUALITY ASSURANCE

- A. Provide submittals in accordance with Section 23 05 00: Common Work Results for HVAC.

1.05 PROJECT RECORD DOCUMENTS

- A. Provide Owner instructions on equipment operation and maintenance procedures, as indicated in Section 23 05 00: Common Work Results for HVAC.

1.06 WARRANTY

- A. Compressors shall be provided with manufacturer's five year warranty, replacement only.
- B. Manufacturer shall warrant parts, except heat exchangers, for a period of five years.
- C. Heat exchangers shall be provided with manufacturer's ten year warranty, replacement only.

PART 2 – PRODUCTS

2.01 EQUIPMENT

- A. Capacities of air conditioning equipment indicated on Drawings are net capacities actually required. Standard catalog ratings shall be adjusted to actual Project site environmental conditions.

2.02 ROOF MOUNTED POWER EXHAUST VENTILATORS

- A. RMEV-1

- 1. Manufacturer:

GREENHECK	LOREN COOK
GB Series	ACEB

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2. Spun aluminum, roof mounted, belt driven, downblast centrifugal exhaust ventilator, with components as indicated and specified. Sizes, performances, and accessories shall be as indicated on equipment schedules on Drawings. Provide required accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.
3. Certification: Fan shall be listed by Underwriters Laboratories Inc (UL 705). Fan shall bear AMCA Certified Ratings Seals for Fan Sound and Air Performance.
4. Housing: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 18 gage Aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The discharge baffle shall have a rolled bead for added strength. A two piece top cap shall have stainless steel, or galvanized quick release latches to provide access into motor compartment without use of tools, or screws. An integral conduit chase shall be provided through curb cap and into motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 16 gage steel power assembly, isolated from unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate.
5. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.
6. Motor: Motor shall be heavy-duty ECM type with permanently lubricated sealed ball bearings and furnished at specified voltage, phase, and enclosure.
7. Bearing: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
8. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision-machined cast iron type, or heavy gauge

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galvanized steel, keyed and securely attached to wheel and motor shafts. Drives shall be sized for 150 percent of installed motor horsepower. The variable pitch motor drive must be factory set to specified fan RPM.

B. RMEV-2:

1. Manufacturer:

GREENHECK	LOREN COOK
G Series	ACED

2. Spun aluminum, roof mounted, direct driven, downblast centrifugal exhaust ventilator, with components as indicated and specified. Sizes, performances, and accessories shall be as indicated on equipment schedules on Drawings. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.
3. Certification: Fan shall be listed by Underwriters Laboratories Inc. (UL 705). Fan shall bear AMCA Certified Ratings Seals for Fan Sound and Air Performance.
4. Housing: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 18 gage Aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The discharge baffle shall have a rolled bead for added strength. An integral conduit chase shall be provided through curb cap and into motor compartment to facilitate wiring connections. The motor shall be enclosed in a weather-tight compartment, separated from exhaust airstream. Unit shall bear an engraved aluminum nameplate.
5. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. An aerodynamic aluminum inlet cone shall be provided for maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.
6. Motor: Motor shall be heavy-duty ECM type with permanently lubricated sealed bearings and furnished at specified voltage, phase, and enclosure.

C. RMEV-3:

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1. Manufacturer:

GREENHECK	LOREN COOK
CUBE Series	ACRUB

2. Spun aluminum, roof mounted, belt driven, upblast centrifugal exhaust ventilator, with components as indicated and specified. Sizes, performances, and accessories shall be as indicated on equipment schedules on Drawings. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.
3. Certification: Fan shall be listed by Underwriters Laboratories Inc. (UL 705). Fan shall bear AMCA Certified Ratings Seals for Fan Sound and Air Performance.
4. Housing: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 18 gage Aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have a one piece inlet spinning and continuously welded curb cap corners for maximum leak protection. The windband shall have a rolled bead for added strength. A two piece top cap shall have stainless steel, or galvanized quick release latches to provide access into motor compartment without use of tools, or screws. An integral conduit chase shall be provided into motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 16 gage steel power assembly, isolated from unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate.
5. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.
6. Motor: Motor shall be heavy-duty ECM type with permanently lubricated sealed ball bearings and furnished at specified voltage, phase, and enclosure.
7. Bearing: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy-duty regreasable ball type in a cast iron pillow block housing selected for a

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minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

8. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron, or galvanized steel type, keyed and securely attached to wheel and motor shafts. Drives shall be sized for 150 percent of installed motor horsepower. The variable pitch motor drive must be factory set to specified fan RPM.

D. RMEV-4:

1. Manufacturer:

GREENHECK	LOREN COOK
CUE Series	ACRUD

2. Spun aluminum, roof mounted, direct driven, upblast centrifugal exhaust ventilator, with components as indicated and specified. Sizes, performances, and accessories shall be as indicated on equipment schedules on Drawings. Also, provide accessories for proper operation and balancing of fans in accordance with design intent and sequence of operation.
3. Certification: Fan shall be listed by Underwriters Laboratories Inc. (UL 705). Fan shall bear AMCA Certified Ratings Seals for Fan Sound and Air Performance.
4. Housing: Fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 18 gage Aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have a one piece inlet spinning and continuously welded curb cap corners for maximum leak protection. The windband shall have a rolled bead for added strength. An integral conduit chase shall be provided into motor compartment to facilitate wiring connections. The motor shall be enclosed in a weather-tight compartment, separated from exhaust airstream. Unit shall bear an engraved aluminum nameplate.
5. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. An aerodynamic aluminum inlet cone shall be provided for maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204, Balance Quality and Vibration Levels for Fans.

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6. Motor: Motor shall be heavy-duty ECM type with permanently lubricated sealed bearings and furnished at specified voltage, phase, and enclosure.

2.03 FILTERS

- A. Air filter media shall be minimum 2-inch thick, MERV 13 Class 2, 100% synthetic, high capacity, pleated, disposable type, with support grid and enclosing frame, continuously laminated on a supporting moisture resistant beverage board type frame that conforms to the configuration of the pleats. Media shall be glued to the frame along all four sides and glued horizontally & diagonally to grill members on both sides. The media shall be unaffected by water and humidity, be non-toxic, non-allergenic, and shall not support the growth of any fungi or bacteria. Filter shall have rigid outer frame that will not bend or distort under normal usage. Filter shall be UL 900 listed, Class 2.
- B. Filter media shall provide an average efficiency as specified on drawings per ASHRAE Standard 52.2.
- C. Initial resistance of air filters shall not exceed following limits for each efficiency level at face velocities indicated. Lower resistance requirements, if indicated on drawings shall have precedence.
- | | |
|----------------------|---|
| 85 percent (MERV 13) | 0.30 inch water gage at 500 feet per minute |
| 95 percent (MERV 14) | 0.38 inch water gage at 500 feet per minute |
- D. Use standard size Filter Medias only.
- E. Media support shall be a welded wire grid or a rigid frame with an effective open area of not less than 96 percent.
1. Media support shall be bonded to filter media to eliminate possibility of media oscillation and media pull-away.
 2. Media support grid shall be formed in such a manner that it effectively forms a radial pleat design, providing total use of filter media.
- F. Enclosing frame shall be bonded to air entering and air exit side of each pleat, to ensure pleat stability. Inside periphery of enclosing frame shall be bonded to filter pack, thus eliminating possibility of air bypass.
- G. Holding frames shall be factory fabricated of 16 gage galvanized steel, or equivalent and shall be furnished with gaskets and spring type positive sealing fasteners. Fasteners shall be capable of being attached or removed without use of tools.
- H. Manufacturers: Camfil Farr, Koch, or AAF.

2.04 LOUVERS, AIR CONDITIONING (use in conjunction with relief damper)

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- A. Standard steel louvers shall be furnished complete with frames, blades, finish and construction details per Drawings and manufacturer's recommendations.
- B. Louvers shall be furnished with horizontal blades, 2 inches deep for air through wall installation in conjunction with gravity relief damper for backdraft protection that will open at 0.01-inch wc room static pressure as indicated on Drawings. Blades shall be 16-gage steel, spaced at 1 7/8-inch at 30 degrees angle, and with baked epoxy coating. Panel size shall be as indicated but not less than 24 inches width by 18 inches in height.

PART 3 – EXECUTION

1.01 GENERAL

- A. Examine areas under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

1.02 EQUIPMENT FOUNDATIONS

- A. Provide foundations (housekeeping pads, level platforms or curbs) for mechanical equipment whether indicated on drawings or not. Equipment foundations shall be of sufficient size and weight, and of proper design to preclude shifting of equipment under operating conditions, or under abnormal conditions imposed upon equipment.
- B. Provide foundations (housekeeping pads, level platforms or curbs) for mechanical equipment whether indicated on drawings or not. Foundations shall meet requirements of equipment manufacturer and, when required by Architect, obtain from equipment manufacturer, approval of foundation design and construction, for equipment to be installed. Equipment vibration shall be maintained within design limits, and shall be dampened and isolated. Isolators shall be bolted to a structural member so as to be readily removable.

1.03 EQUIPMENT DESIGN AND INSTALLATION

- A. Uniformity: Unless otherwise specified, equipment of same type or classification shall be product of same manufacturer.
- B. Application: Only provide equipment as reviewed by Architect.
- C. Equipment Installation: Equipment installation shall be in strict accordance with these Specifications, and installation instructions of manufacturers. Equipment installed on concrete foundations shall be grouted before piping is installed. Piping shall be installed in such a manner as not to place a strain on equipment. Flanged joints shall be adequately extended before installation. Piping shall be graded, anchored, guided and supported, without low pockets.

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1. Install equipment in a neat and skillful manner, properly aligned, leveled, and adjusted for satisfactory operation.
2. Install so connecting and disconnecting of piping and accessories can be readily accomplished, parts are readily accessible for inspection, service and repair. Space shall be provided to readily remove filters, coils, compressors and fan wheels. Access doors shall be hinged with cam lock door handles.
3. Provide flexible connections for duct, pipe and conduit connections at moving equipment.

1.04 ROOF-TOP EQUIPMENT MOUNTING

- A. Downflow Packaged Units: Install unit on a prefabricated mounting frame or curb secured directly to roof. Follow manufacturers recommended installation manuals. Submit Shop Drawings for review by Architect.
- B. Horizontal Flow Packaged Units: Install unit on platform or prefabricated mounting frame or curb secured directly to roof designed to suit roof conditions and requirements of provided unit. Submit Shop Drawings for review by Architect.

1.05 REFRIGERANT PIPING INSTALATION

- A. Unless otherwise indicated, main liquid and suction lines from condensing unit to Indoor coil shall be of sizes specified by manufacturer.
- B. Refrigeration piping shall be refrigeration grade copper tubing, type L hard-drawn. In instances where refrigeration lines are installed in an inaccessible location and must be snaked through conduit or a trench, that portion of tubing required to complete connections through conduit or trench may be soft drawn. Maintain entire system clean and dry during installation. Pipe shall be sealed until installed.
- C. Refrigeration piping, both hard and soft-drawn, shall be straight and free from kinks, restrictions and horizontal runs shall be sloped towards compressor one inch to 10 feet wherever possible. Vapor line oil traps shall be installed on bottom of vertical risers and inverted oil trap shall be installed on top of vertical risers.
- D. Joints shall be installed with Sil-Fos 15, Silvaloy 15, or equal.
- E. Flare nuts required on suction lines shall be of short forged or frost-proof type. Other fittings shall be standard sweat-soldered type. Ells and return bends shall be long radius type. Install leak lock material.
- F. Refrigeration Piping: Joints shall be silver brazed and tested according to the section 23 0500 "Common Work Results for HVAC". Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter. Field fabricated lines shall be thoroughly deburred, flushed and cleaned before connection. Bleed nitrogen through

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lines during silver brazing, maintain Nitrogen flow rate of 1.75 cubic feet per minute or more using a pressure regulator. Cap and seal lines when not completed and connected to equipment.

1. Brazing or Debrazing shall always be conducted with nitrogen purging through the refrigeration system.
 2. Arrange a refrigerant piping pre-installation conference between Contractor, Architect, IOR, and OAR to review and confirm installation method.
 3. Do not charge refrigerant through the split system prior to testing procedure by contractor and acceptance by Owner.
- G. Sleeve penetrations of floors, walls and ceiling to allow for free motion of piping. Provide 24 gage galvanized iron pipe and chrome-plated escutcheon plates. Pack annular space between pipe and sleeve with incombustible material such as fiberglass and seal each end with mastic to provide a waterproof seal.
- H. Install insulated couplings at points of connection between dissimilar metals for cathodic protection. Insulate copper tubing from ferrous materials and hangers with 2-inch thickness of 3-inch wide strip, 10 mil polyvinyl tape wrapped around pipe.
- I. Support piping by iron hangers and supports. Hydra-Zorb cushion clamps, LSP Products Group Acousto Clamp, or equal, on non-insulated piping, and Klo-Shure coupling clamp on insulated piping, or equal.
- J. Provide saddles to protect pipe insulation.
- K. Provide connections of copper, copper plated steel, steel, and brass pipe and tubing with Harris Products Group Safety-Silv 56, Lucas-Milhaupt, Inc., or equal, complying with ANSI/AWS A5.8 and NSF 51.
- L. Insulate refrigerant suction lines.
- M. On split systems, insulate both vapor and liquid lines. For insulation materials, refer to Section 23 07 00: HVAC Insulation.
- 1.06 NOISE AND VIBRATION
- A. Operation of Equipment: Mechanical equipment and piping systems shall operate without exceeding specified noise and/or vibration levels.
- B. Corrective Measures: If specified noise and/or vibration levels are exceeded, provide necessary changes to reduce noise and/or vibration levels to within specified levels.

1.07 FIELD TESTS AND INSPECTION

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- A. General: Perform field inspections, field tests, and trial operations as specified in Section 23 05 00: Common Work Results for HVAC. Provide labor, equipment and incidentals required for testing. The Project Inspector will witness field tests and trial operations as specified in Section 23 05 00: Common Work Results for HVAC.
- B. Equipment and Material: Equipment and material certified as being successfully tested by manufacturer, in accordance with referenced Specifications and standards, will not require re-testing before installation. Equipment and materials not tested at place of manufacture will be tested before or after installation, as applicable or necessary, to determine compliance with reference Specifications and standards.
- C. Start-Up and Operational Test: System shall be started up and initially operated with components operating. During this test, various strainers or filters shall be periodically cleaned until no further accumulation of foreign material occurs. Adjust safety and automatic control instruments as required to provide proper operation and control sequence. Refer to Section 23 05 00: Common Work Results for HVAC.
- D. Extent of Field Tests: After installation and before completion, Work of this Section shall be subjected to required field tests, including those specified here and in Section 23 05 00: Common Work Results for HVAC.
- E. Operation and Maintenance Data: Provide required operation and maintenance data as specified in Section 23 05 00: Common Work Results for HVAC.

1.08 CLEANUP

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

1.09 PROTECTION

- A. Protect Work of this Section until Substantial Completion.

3.10 STANDARDS AND CERTIFICATIONS

- A. All units must be:
 - 1. ETL certified duct furnace(s) which conform to the latest ANSI standards for efficiency and safe performance.
 - 2. ETL or UL certified for electrical safety in compliance with UL 1995 safety standard for heating, ventilation and cooling equipment
 - 3. Compliant with FM (Factory Mutual) requirements
- B. Fuel Types
 - 1. Rooftop unit will be suitable for operation with natural gas.

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3.11 FUEL TYPES

- A. Rooftop unit will be suitable for operation with natural gas.

3.12 MECHANICAL ARRANGEMENT

- A. Rooftop unit will consist of a furnace section consisting of a single furnace. The firing rate of each furnace will not exceed 400 MBh and will contain its own heat exchanger, flue collector, venting, burners, safety and ignition controls.
- B. Rooftop unit will consist of a blower section containing supply blower(s) and blower motor. The blower motor will be interlocked electrically and disengage the blower motor and control circuit upon opening the service panel.
- C. Rooftop unit will consist of an electrical cabinet that is isolated from the air stream with a non-removable access panel interior to the outer service panel. Provision for component mounting, wire routing, and high voltage isolation
- D. Rooftop unit will be provided with outside air opposed blade damper(s).
- E. Rooftop unit will consist of a filter section to accommodate 2" MERV 13 filter and be of a design for minimal pressure drop.

3.13 ELECTRICAL SYSTEMS

- A. All electrical components and fixtures will carry UL or ETL and/or CSA listing certification and/or recognition.
- B. All wire will be rated to meet or exceed electrical requirements for voltage, ampacity, dielectric strength of sheathing and temperature rating per location.
- C. Standard control relays will be socket mounted with terminal block connections.
- D. All high voltage wiring will be enclosed in flexible metallic sheathed BX cable and include an identifying marker corresponding to the wiring diagram.

3.14 MOUNTING

- A. Rooftop unit will be mounted on metal rails with down rolled outer edges with lifting and anchor holes and be suitable for slab or curb mounting.

3.15 STANDARD SAFETY PROVISIONS

- A. Rooftop unit will be provided with a low voltage circuit breaker rated for 150% of the unit's normal 24-volt operating load.

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- B. An access interlock switch will be installed in the blower compartment and will disengage the blower upon removing the service panel. An override or cheat switch will be incorporated into the interlock switch for serviceability.
- C. Each duct furnace will be provided with a primary limit switch, 24V high temperature limit switch and a (redundant) combination gas valve.
- D. Rooftop units will contain a reverse air flow interlock switch. The normally closed switch when activated will cause gas valve to close.
- E. A drafter prove switch will be installed in all power vented units and disengage gas flow if for any reason the drafter has failed to operate.
- F. Warning labels will be visible in accessible areas of the rooftop where unsafe conditions could occur.

3.16 BURNERS

- A. Burners will be die formed with stamped porting and stainless-steel port protectors to prevent scale or foreign matter from obstructing the burner ports. Burner construction will consist of corrosion resistant aluminized steel.
- B. Burners must be individually removable for ease of cleaning and servicing. The entire burner assembly must be easily removable with a slide-out drawer design. The pilot must be accessible through a pilot access panel without removing the burner assembly.

3.17 HEAT EXCHANGER

- A. The heat exchanger construction will consist of 20-gauge 409 stainless steel tubes and 20-gauge headers.

3.18 VENTING SYSTEM

- A. The flue collector construction will consist of corrosion resistant aluminized steel.
- B. Rooftop will be provided with power venting. Outside air for combustion and products of combustion will have individual air inlet and discharge grilles located in the upper section of the furnace service panel. A drafter prove switch will be installed and its normally open contacts wired in series with the main gas valve.

3.19 CABINETS

- A. Cabinetry will be die-formed, 20-gauge corrosion resistant ZAM (Zinc, Aluminum and Magnesium) steel with acrylic finish coat.

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- B. Hinged access doors will be provided by the manufacturer on the blower and filter cabinet doors. Doors will be double wall construction and incorporate dual quick opening tool-less latches. Door stops will be included to prevent against closure while open.
- C. Blower/filter sections will be insulated with fire resistant, environmentally safe, odorless, one inch fiber material. It will be matte faced.

3.20 DAMPERS

- A. Dampers will be of the opposed blade type. Constructed of galvanized steel with neoprene nylon bushings. Blades to be mechanically interlocked.

3.21 FILTER RACK

- A. Filter rack will be constructed of galvanized steel with access through the side service panel.

3.22 INTAKE HOOD

- A. Intake hood will be constructed of galvanized steel and include a bird screen.

3.23 SUPPLY BLOWER

- A. Supply blower will be belt drive, forward curved, centrifugal type blower assembly, statically and dynamically balanced with double inlet. The blower well will be fixed on a shaft, supported with super quiet rubber cartridges for vibration isolation, and ball bearing.

3.24 BLOWER MOTOR

- A. Motor will be single speed, ball bearing drive, permanently lubricated, EPACT compliant, standard NEMA frame size and service factory, with resilient base and Class B windings.
- B. Motor will be of the voltage and horsepower as scheduled.
- C. Motor wiring will be enclosed in flexible metallic sheathed BX conduit.
- D. Motor will be activated through a magnetic starter with IEC overload protection.

3.25 GAS AND IGNITION SYSTEM

- A. A solid-state ignition control system which ignites the pilot by spark during each cycle of operation will be provided. When a pilot flame is proven, the main burner valve will open to allow gas flow to the burners. Pilot and burners must be extinguished during the off cycle.

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- B. Rooftop units will be provided with a gas valve suitable for NEC Class 2 use, for a maximum inlet of 0.5 psi (14" W.C.) on natural gas. The 24-volt combination automatic gas valve must include a main operating valve, pilot safety valve, pressure regulator, manual main and pilot shutoff valve and adjustable pilot valve.

3.26 GAS CONTROLS

- A. Single stage unit will be provided with one stage of heat. Ignition is the full rate of the furnace(s) rated input.

3.27 DAMPER MOTOR

- A. Damper motor will be two positions with spring return. Motor will operate at 24 volts.
- B. Motor and control wiring will be harnessed with terminal block connections. Wire will have a temperature rating of at least 105C outside of the duct furnace.

3.28 DAMPER CONTROL

- A. Two position spring return motor with outside air damper will be provided. The motor will power the outside air damper full open when the units is on and full closed with the unit is off.

3.29 ACCESSORIES

- A. Rooftop unit will be provided with an airflow prove switch to verify airflow through the unit. The switch will be a Dwyer 1910-0 pressure switch suitable for duct mounting with a range of 0.15-0.50" W.C.

PART 4 - EXECUTION

4.01 EXAMINATION

- A. Contractor shall verify that roof is ready to receive work.
- B. Contractor shall verify that proper power supply is available.

4.02 INSTALLATION

- A. Contractor shall install in accordance with manufacturer's instructions.
- B. Mount units on factory-built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

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END OF SECTION

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SECTION 23 81 29 - VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 23 05 00 - Common Work Results for HVAC.
 - 3. Section 23 05 48 - Vibration and Seismic Controls for HVAC.
 - 4. Division 26 - Electrical.

1.02 REFERENCES

- A. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
- B. ANSI/ASHRAE 62.1 – Ventilation for Acceptable Indoor Air Quality.
- C. ANSI/ASHRAE/IES Standard 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- D. ASTM International:
 - 1. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 2. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - 3. ASTM D1418 - Standard Practice for Rubber and Rubber Latices-Nomenclature.
- E. International Organization for Standardization (ISO):
 - 1. ISO3745 Standard - Acoustics -- Determination of sound power levels and sound energy levels of noise sources using sound pressure -- Precision methods for anechoic rooms and hemi-anechoic rooms.

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1.03 SUBMITTALS

- A. Provide in accordance with Division 01, General Requirements, and Section 23 0500, Common Work Results for HVAC.
- B. Product Data: Submit performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
 - 1. Complete materials list of items proposed to be furnished and installed under this Section. Materials lists, which do not require performance data, shall include manufacturer's name, type, and model number for indicated installation.
 - 2. Manufacturer's specifications and other data required to demonstrate compliance with specified requirements. Literature shall include descriptions of equipment, types, models and sizes proposed, performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, electrical requirements, options selected, space requirements and other data necessary to ensure compliance with requirements of this Specification and performances indicated on Drawings.
- C. Shop Drawings indicating methods of installation of equipment and materials, and details of supporting structures for items indicated. Items to be submitted shall include but not be limited to the following:
 - 1. Layout Drawings of Equipment: Include plans, elevations, and sections, of proposed equipment drawn to scale, to establish which equipment shall fit in allotted spaces with clearance for installation and maintenance. Indicate proposed details for attachment. Indicate vibration isolation units, foundations, supports, and openings for passage of pipes and ducts.
 - 2. Electrical interlock or control diagrams for electrically controlled components furnishing more than one automatic or manual control devices, which are not indicated on Drawings.
- D. Manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. Qualifications of Manufacturers and Installers: Comply with provisions in Section 23 0500: Common Work Results for HVAC.
- B. Installers shall be certified by VRF manufacturer and have a minimum of 3 VRF projects of comparable size and complexity.

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1.5 WARRANTY

- A. Manufacturer shall warrant all parts for a period of ten (10) years from date of Substantial Completion.

1.6 TRAINING

- A. Training for OWNER Staff off-site by the VRF manufacturer.
1. Training sessions shall not exceed 8 hours per day.
 2. Training session shall accommodate a minimum of 20 personnel and be facilitated at a location no more than 50 miles from OWNER's location.
 3. Training sessions shall provide manufacturer's required hours of training for the staff to be factory certified to be able to maintain, repair and service the equipment.
 4. Training shall provide specifications, drawings, cut sheets manuals, computers/laptops and other supportive documents and materials required for training and certifications.
 5. At the conclusion of training, the manufacturer shall provide certification for each attendee acknowledging their attendance and knowledge for maintenance, service and repair of the system.
 6. Training and certification shall include all components of VRF system requiring maintenance, service and repair but not limited to condensing units, branch controller boxes, fan coils, leak detection, controls piping and trouble shooting.
 7. Training shall include hands-on training, demonstrating replacing and reprogramming of components in order to restore to full operational condition and shall not be limited to presentation materials only.
 8. OWNER's employees attending this training session shall be provided with the following documentation:
 - a. System layout and Installation Checklist.
 - b. System controls and EMS interface and Operation and Maintenance Instruction.
 - c. Component isolation technics.
 - d. Refrigerant and oil management and replacement.
 - e. Unit component diagnostic system and points.

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- B. Training for OWNER's staff on-site: The training sessions shall not exceed four hours per day and shall be conducted by the VRF manufacturer's technical staff regarding overall Maintenance and Operation of the entire VRF system. On-site training shall allocate sufficient hours for the staff to have a good understanding of the system, components and maintenance, service and repair requirements. All supporting documents, manuals, cut sheets, spare parts shall be provided as required to maintain and service the system. The training shall consist of, but not be limited to the following:
1. System layout and Operation and Maintenance Manuals.
 2. Trouble shooting and diagnostic protocol.
 3. Leak detection/prevention strategy.
 4. Routine Maintenance requirements.
 5. System isolation points, installation checklist, system controls and EMS interface, refrigerant and oil management and verification of all component locations.
- C. For additional training requirements refer to Sections 23 0500, Common Work Results for HVAC and 23 0800, HVAC Systems Commissioning.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Equipment listed on this Section shall be manufactured by: LG, Daikin, Mitsubishi and Samsung.
1. Basis of Design: Samsung
- B. Capacities of the equipment indicated on the drawings are net capacities.

2.02 IN-CEILING CASSETTE DUCTLESS UNITS

A. General

1. Unit shall be factory assembled, wired, piped and run tested.
2. Unit shall be designed to be installed for indoor application.
3. Unit shall be designed for mounting in the finished ceiling.
4. Unit shall be capable to be installed with heat pump or heat recovery or cooling VRF system.

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B. Unit Cabinet:

1. Cabinet shall be constructed of zinc-coated steel.
2. Fully insulated discharge and inlet grilles shall be attractively styled, high-impact non-metallic material.
3. The inlet grille shall have hinges and can be opened to obtain access to the cleanable filters, indoor fan motor and control box.

C. Fan Assembly:

1. Fan shall be centrifugal direct-drive blower type with air intake in the center of the unit and discharge at the perimeter. Automatic, motor-driven vertical air sweep shall be provided standard. Automatic motor-driven louvers shall be provided standard and shall be adjustable for 2, 3 or 4-way discharge.
2. Air sweep operation shall provide three user selectable modes.

D. Coil:

1. Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion and specially coated for enhanced wet-ability. A drip pan under the coil shall have a factory installed condensate pump and drain connection for hose attachment to remove condensate. A replaceable element in the condensate disposal system provides antibacterial protection.

E. Motors:

1. Motors shall be totally enclosed, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be inverter controlled variable speed.

F. Microprocessor Control:

1. Unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
2. Unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, 2 core, stranded and shielded communication cable.
3. Unit controls shall operate the indoor unit using one of the five operating modes:
 - a. Auto changeover (Heat Recovery System only).
 - b. Heating.

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- c. Cooling.
 - d. Dry.
 - e. Fan only.
- G. Filters:
- 1. Unit shall have factory-supplied resin net (cleanable) type filters. The return air filter material shall have the following characteristics:
 - a. Odorless
 - b. Temperature resistant to 185°F
 - c. Humidity resistant up to 95% RH
 - d. MERV 8 or Better
- H. Electrical: Unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.
- I. Controls: Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.

2.03 EVAPORATOR-FAN UNIT (HORIZONTAL DUCTED HIGH STATIC)

A. General

- 1. Unit shall be factory assembled, wired, piped and run tested.
- 2. Unit shall be designed to be installed for indoor application.
- 3. Unit shall be designed to mount fully concealed above the finished ceiling.
- 4. Supply air shall be flanged for field installed ductwork that shall not exceed the external static pressure limitation of the unit.
- 5. Unit shall be capable to be installed with heat pump or heat recovery or cooling VRF system.

B. Casing/Panel:

- 1. Unit case shall be manufactured using galvanized steel plate.
- 2. Cold surfaces of the unit shall be covered internally with a coated polystyrene insulating material.

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3. Cold surfaces of the unit shall have internal insulation.
4. External insulation shall be plenum rated and conform to ASTM D1418.
5. Unit shall be provided with hanger brackets designed to support the unit weight on four corners.
6. Hanger brackets shall have pre-punched holes designed to accept field supplied, all thread rod hangers.

C. Cabinet Assembly:

1. Unit shall be equipped with factory installed temperature thermistors for:
 - a. Return air.
 - b. Refrigerant entering coil.
 - c. Refrigerant leaving coil.
2. Unit shall have a factory assembled, piped and wired electronic expansion valve (EEV) for refrigerant control.
3. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
4. Unit shall have the following functions as standard:
 - a. Self-diagnostic function.
 - b. Auto restart function.
 - c. Auto changeover function (Heat Recovery system only).
 - d. Auto operation function.
 - e. Forced operation.
 - f. Dual thermistor control.
 - g. External static pressure (ESP) control.

D. Fan Assembly:

1. Unit shall have direct driven fan(s).
2. Fan shall be made of high strength resin.
3. The fans shall be mounted on a common shaft.

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4. Fan motor shall be Brushless Digitally controlled (BLDC) with permanently lubricated and sealed ball bearings.
5. Fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
6. Fan speed shall be controlled using microprocessor based direct digitally controlled algorithm.
7. In cooling mode, the indoor fan shall have the following settings: Low, Med, High and Auto.
8. In heating mode, the indoor fan shall have the following settings: Low, Med, High and Auto.
9. The Auto fan setting shall adjust the fan speed to most effectively achieve the set-point.
10. Each of the settings can be field adjusted from the factory setting (RPM/ESP).
11. Unit shall be designed for high speed air volume against an external static pressure of up to 1.0" water gauge.

E. Coil Assembly:

1. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
2. Unit shall have minimum of two rows of coils.
3. Unit shall have a factory supplied condensate drain pan below the coil.
4. Where indicated, horizontal unit shall be installed and wired condensate drain pump capable of providing minimum 27.5 inch lift from bottom surface of the unit.
5. Vertical unit shall be designed for gravity drain.
6. Unit drain pan shall be provided with a secondary drain port/plug allowing pan to be drained for service.
7. Drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan.
8. Coil shall be factory pressure tested at a minimum of 551 psig.

F. Microprocessor Control:

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1. Unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
 2. Unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, 2 core, stranded and shielded communication cable.
 3. Unit controls shall operate the indoor unit using one of the five operating modes:
 - a. Auto changeover (Heat Recovery System only).
 - b. Heating.
 - c. Cooling.
 - d. Dry.
 - e. Fan only.
- G. Electrical: Unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.
- H. Controls: Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS485 daisy chain.
- 2.04 AIR-COOLED, COMPRESSOR-CONDENSER UNIT, HEAT RECOVERY OR HEAT PUMP
- A. General:
1. Each system shall consist of one, two or three air source outdoor unit frame.
 2. Dual and triple frame configurations shall be field piped together using manufacturer's designed and supplied Y-branch kit in conjunction with field provided interconnecting pipe to form a common refrigerant circuit.
 3. Refrigerant circuit configuration for Heat Recovery System.
 - a. Refrigerant circuit shall be constructed using field provided copper piped together with manufacturer supplied Heat Recovery unit(s) ,Y-branches or Header fittings, connected to (ducted, non-ducted or combination thereof) single/multiple indoor units to effectively and efficiently control the simultaneous heating and cooling operation of the VRF system.

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- b. Refrigerant pipe, y-branch, header kit, elbows and isolation ball valves shall be individually insulated with no air gaps. Joints shall be glued and sealed.
 - 4. Factory installed microprocessor controls in the outdoor unit(s), HR unit(s), and indoor unit(s) shall perform functions to efficiently operate the VRF system and communicate in a daisy chain configuration between each other. Communications and cabling shall conform to RS485 standard.
 - 5. Unit shall be shipped from the factory fully assembled including internal refrigerant piping, compressor, contacts, relay(s), power and communications wiring necessary.
 - 6. Refrigeration circuit shall have the following components:
 - a. Refrigerant strainer(s).
 - b. Check valve(s).
 - c. Oil separator.
 - d. Accumulator.
 - e. 4-way reversing valve.
 - f. Vapor injection valve.
 - g. Variable path valve.
 - h. Oil Level sensor.
 - i. Electronic expansion valve(s).
 - j. Sub-cooler.
 - k. High and low side Schrader valve service ports with caps, or service valves.
- B. Unit Cabinet:
- 1. Outdoor unit cabinet shall be made of 20 gauge galvanized steel with an enamel finish.
 - 2. Outdoor unit cabinet finish shall be tested in accordance with ASTM B117 salt spray test procedure.
 - 3. Front panels of outdoor units shall be removable type for access to internal components.

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C. Fan:

1. 6 ton cabinets shall be equipped with one direct drive variable speed propeller fan with Brushless Digitally Controlled (BLDC) motor with a vertical air discharge.
2. 8 to 14 ton cabinets shall be equipped with two direct drive variable speed propeller fan(s) with BLDC motor(s) with a vertical air discharge.
3. Fan(s) motor shall be equipped with permanently lubricated bearings.
4. Fan motor shall be variable speed with a maximum operating speed of 1050 RPM.
5. Fan shall have a raised guard to help prevent contact with moving parts.
6. Cabinet shall have option to change the discharge air direction from vertical to horizontal using optional factory provided air guides.

D. Condenser Coil:

1. Outdoor units shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
2. Copper tubes shall have inner grooves.
3. Aluminum fins shall have factory applied corrosion resistant material.
4. Hydrophilic Coil coating shall be tested in accordance with ASTM B117 salt spray test procedure.
5. Outdoor unit coil shall be tested to a pressure of 551 psig.
6. Cabinet shall have a coil guard.

E. Compressor:

1. Units shall be equipped with two or three inverter driven twin rotary compressors.
2. Inverter driven, twin rotary compressors shall be capable of operating in a frequency range from 15 Hz to 150 Hz with control in 0.5 Hz increments.
3. Compressor(s) shall be equipped with a 60 Watt crankcase heater.
4. Compressor shall use a factory charge of Polyvinyl Ether (PVE) oil.
5. Compressor bearing(s) shall have Teflon™ coating.

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6. Compressor(s) shall be protected with:
 - a. High Pressure switch.
 - b. Over-current /under current protection.
 - c. Phase failure.
 - d. Phase reversal.
 - e. Standard, non-inverter driven compressors shall not be permitted.
- F. Oil Management: System shall have an oil management system as recommended by manufacturer.
- G. Refrigerant Management:
 1. System shall have advanced refrigerant control functions that optimize operating efficiency at all ambient operating conditions. Advanced refrigerant control functions shall include:
 - a. Accumulator shall be equipped with controls that vary the amount of refrigerant charge being circulated based on operating mode.
 - b. Outdoor unit coil shall be equipped with controls that maximizes heat transfer. Controls shall vary the coil circuiting between parallel and series configurations and be able to change flow direction in response to multiple refrigerant monitoring parameters and operating conditions.
 - c. Compressors shall be equipped with an intermediary port that introduces additional refrigerant to the compression chamber based on multiple refrigerant system monitoring parameters. This feature increases heating capacity at low ambient conditions.
- H. Sensors: Each single cabinet shall have:
 1. Suction temperature sensor.
 2. Discharge temperature sensor.
 3. High Pressure sensor.
 4. Low Pressure sensor.
 5. Outdoor temperature sensor.
 6. Outdoor unit heat exchanger temperature sensor.

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2.05 BAS INTERFACE GATEWAY

- A. Provide BTL certified BACnet Gateway allowing complete open protocol, 2 way communication between VRF system and various brands of BAS over BACnet/IP.
- B. An embedded web server shall be incorporated to facilitate troubleshooting and remote diagnostics or serve as an alternative method for manual system control whenever the BAS is offline.
- C. Interface shall be capable of controlling and monitoring up to 256 indoor units with the following functions:
 - 1. Unit Run/stop.
 - 2. Zone Controller Permit/Prohibit.
 - 3. Operation Mode Cool/Dry/Fan/Auto/Heat.
 - 4. Fan Speed Low/Medium/High/Auto.
 - 5. Temperature Setpoint with upper and lower limits.
 - 6. Room Temperature.
- D. Module shall require 120V power.

2.06 DIAGNOSTIC TOOL

- A. Provide an electronic diagnostic tool that can be connected to the VRF controls system at any unit location to provide, via a laptop computer, detailed information about the system and its components.

2.07 REFRIGERANT PIPING

- A. See Section 23 23 00, for refrigerant piping.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- B. Install ground-mounted, compressor-condenser components on a 4-inch-thick, unless otherwise indicated on the drawings, reinforced concrete base. Base shall be a minimum of 4 inches larger on each side than the unit. Concrete, reinforcement, and

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formwork, shall be as specified in Sections 03 1000, Concrete Forming and Accessories, Section 03 2000, Concrete Reinforcing, and Section 03 3000 Cast-in-Place Concrete. Coordinate anchor location and installation with concrete base.

- C. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch. Refer to Section 23 0548, HVAC Sound, Vibration and Seismic Control. Fasten equipment and isolators with removable, cadmium-plated fasteners.

3.02 FIELD INSTALLED REFRIGERANT PIPING

- A. Connect ACR tubing to component's quick-connect fittings. Install tubing to allow access to unit.
- B. Install piping adjacent to unit to allow service and maintenance.
- C. Piping shall be copper with joints brazed with 15% silver, silphos brazing rod, with nitrogen flowing through pipe while brazing.
- D. Elbows shall be of the long radius type.
- E. Liquid and vapor piping shall be insulated with $\frac{3}{4}$ " thick closed cell rubberized insulation.
- F. Piping shall be secured to structure with straps, taking care to ensure that the refrigerant piping does not contact the structure and that the insulation is not torn.
- G. All copper piping shall be brazed while purging air with dry nitrogen gas.
- H. Initial leak test shall be performed per the manufacturer's installation guide, with dry nitrogen gas on all field installed piping simultaneously, to not less than 500 psi.
- I. Piping shall be evacuated with a triple-evacuation process, breaking with dry nitrogen between steps, to 4000 microns, 1500 microns, and finally <500 microns. Perform rise test of <500 microns for at least one hour.

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Leak Test: After installation:
 - 1. Pressure test the system with Nitrogen for (24) hours at 550 PSIG. Repair any leaks and retest until no leaks exists.

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2. Vacuum test the complete system at 500 microns for (24) hours.
 3. A factory authorized technician shall verify the leak tests were completed before charging the system.
- 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.

3.04 CLEAN UP

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

3.05 PROTECTION

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

END OF SECTION

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SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26. It expands and supplements the requirements specified in sections of Division 01.

- B. Related Requirements:
 - 1. Division 01 – General Requirements.
 - 2. Section 03 30 00 – Cast-in-Place Concrete.
 - 3. Section 09 90 00 – Painting and Coating.
 - 4. Division 14 – Conveying Equipment.
 - 5. Division 23 – HVAC.
 - 6. Division 26 – Electrical.
 - 7. Division 27 – Communications.
 - 8. Division 28 – Electronic Safety and Security.
 - 9. Division 31 – Earthwork.
 - 10. Division 33 – Site Improvements.

- C. Related Industry Standards: The most current version of the following industry standards.
 - 1. ASTM D 709 – Laminated Thermosetting materials.
 - 2. ANSI/NEMA FB-1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
 - 3. ANSI/NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 4. California Electrical Code (CEC).
 - 5. IEEE C57.12.28 – Standard for Pad-Mounted equipment Enclosure Integrity.
 - 6. IEEE 1584 – Performing Arc-Flash Hazard Calculations.
 - 7. UL/ANSI 1 – Standard for Flexible Metal Conduit.

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8. UL/ANSI 1242 – Standard for Electrical Intermediate Metal Conduit.
9. UL/ANSI 506 – Standard for Specialty Transformers.
10. UL/ANSI 6 – Electrical Rigid Metal Conduit-Steel.
11. UL/ANSI 6A – Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel.
12. UL 797 – Electrical Metallic Tubing-Steel.
13. UL/ANSI 870 – Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
14. UL/ANSI 891 – Standard for Safety Switchboards.

1.02 BASIC ELECTRICAL REQUIREMENTS

A. Quality Assurance:

1. Work shall be performed by CONTRACTOR'S personnel possessing the skills and experience obtained in performing work of similar scope and complexity.
2. Refer to related division(s) specifications for other requirements.

B. Drawings and Specifications Coordination:

1. For purposes of clearness and legibility, Drawings are essentially diagrammatic, and the size and location of equipment is indicated to scale whenever possible. Verify conditions, dimensions, indicated equipment sizes, and manufacturer's data and information as necessary to install the Work of this Division. Coordinate location and layout with other Work.
2. Verify final locations for rough-in with field measurements and with the requirements of the equipment to be connected.
3. Drawings indicate required size and points of termination of conduits, number and size of conductors, and diagrammatic routing of conduits. Install conduits with minimum number of bends to conform to structure, avoid obstructions, preserve headroom, keep openings and passageways clear, and comply with applicable code requirements.
4. Routing of conduits may be changed provided that the length of any conduit run is not increased more than 10 percent of length indicated on the Drawings.
5. Outlet locations shall be coordinated with architectural elements prior to start of construction. Locations indicated on the Drawings may be distorted for clarity; CONTRACTOR shall coordinate in the field prior to rough-in work.
6. Coordinate electrical equipment and materials installation with building components and the Work of other trades.
7. Equipment disconnects shall be readily accessible and free of obstructions.

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8. When extending or intercepting existing electrical facilities, CONTRACTOR shall Coordinate and verify existing conditions.

C. Terminology:

1. Signal Systems: Applies to clock, bell, fire alarm, annunciator, sound, public address, buzzer, telephone, television, inter-communication, elevator access controls, lighting control systems and security systems.
2. Low Voltage: Applies to signal systems operating at 120 volts and less, and power systems operating at less than 600 volts. Medium voltage: Applies to power systems operating at more than 600 volts.
3. UL: Underwriter's Laboratories Inc, Nationally Recognized Testing Laboratory (NRTL), or equal.

D. Regulations: Work shall comply with the requirements of authorities having jurisdiction and the California Electrical and Building Codes. Material shall conform to regulations of the National Board of Fire Underwriters for electrical wiring and apparatus. Materials shall be new and listed by UL, or another NRTL.

E. Structural Considerations for Conduit Routing:

1. CONTRACTOR shall provide DSA approved calculations and drawings as necessary for any construction and/or alterations requiring conduits to pass through or interfere with any structural members, or where notching, boring or cutting of the structure is necessary, or where special openings through walls, floors, footings, or other buildings elements, or where notches and bored holes in wood or steel are required. All work shall conform to CBC, Part 2, Title 24 requirements.
2. Concrete encasement for underground conduits that abuts a foundation wall or underground structure shall rest on a haunch integral with wall or structure, or shall extend down to footing projection, or shall be doweled into structure unless otherwise indicated. Underground structures shall include maintenance holes; pull boxes, vaults, and buildings.

F. Electrically Operated Equipment and Appliances:

1. Furnished Equipment and Appliances:
 - a. Work shall include furnishing and installing wiring enclosures and complete connections of electrically operated equipment, appliances and electrical control devices, which are specified to be furnished and installed in this or other sections of the Specifications. Wiring enclosures shall be concealed except where exposed work is indicated on the drawings.
 - b. Provide all connections necessary for installation of equipment. Equipment shall be tested for proper operation, including proper rotation of motorized equipment. If outlets are of incorrect electrical characteristics, or any specified equipment

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fails to operate properly, CONTRACTOR shall repair and/or replace the outlet and/or equipment.

2. Equipment and Appliances Furnished by Others:

- a. Equipment and appliances indicated on Drawings as "Not In Contract" (NIC), "furnished by others," or "furnished by the OWNER," will be delivered to the Project site. Required electrical connections shall be performed for such equipment and appliances. Motorized equipment will be furnished factory-wired to a control panel or junction box unless otherwise indicated. Appliances will be furnished equipped with portable cord and cap. Provide disconnect switches where required.
 - b. Connections to equipment furnished under this Division shall be part of the Work of this section. Work shall include internal wiring, installation, connection and adjustment of bolted drive motors in which the motor is supplied as a separate unit, and connections only for equipment furnished with factory installed internal wiring, except as further limited by Drawings and this Specification. Work shall include furnishing and installing suitable outlets, disconnecting devices, starters, push-button stations, selector switches, conduit, junction boxes, and wiring necessary for a complete electrical installation. Work shall also include furnishing and installing conduit and boxes for HVAC control systems, furnished under Division 23. Devices and equipment furnished shall be of same type used elsewhere on the Work or as specified.
 - c. Electrical equipment furnished under other sections, for installation and connection under Work of this section, will be delivered to the Project site ready for installation.
 - d. Mechanical equipment furnished under other sections, and requiring electrical connection under this section, will be set in place as part of the Work of the section furnishing such equipment unless noted otherwise.
 - e. Suitability and condition of equipment furnished under other sections shall be determined in advance of installation. Immediate notice of damage, unsuitability, or lack of parts shall be given to the entity providing such equipment.
- G. Power Distribution System Reports: For fault current, coordination and Arc-Flash system report requirements refer to applicable electrical distribution equipment sections. for specific requirements.
- H. Protection of Materials:
- 1. Protect materials and equipment from damage and provide adequate and proper storage facilities during progress of the Work. Damaged materials and/or equipment shall be replaced.

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- I. Cleaning:
 - 1. Exposed parts of Work shall be left in a neat, clean, usable condition. Finished painted surfaces shall be unblemished and metal surfaces shall be polished.
 - 2. Thoroughly clean parts of apparatus and equipment. Exposed parts to be painted shall be thoroughly cleaned of cement, plaster, and other materials. Remove grease and oil spots with solvent. Such surfaces shall be wiped, and corners and cracks scraped out. Exposed rough metal shall be smooth, free of sharp edges, carefully steel brushed to remove rust and other spots, and left in proper condition to receive finish painting.
 - 3. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

- J. WARRANTIES
 - 1. Provide one-year warranty on all material and labor performed, unless noted otherwise in specific sections.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Advise the Inspector before starting the Work of this Division.
- B. Exposed conduits shall be painted to match the surfaces adjacent to installation.
- C. Salvaged materials removed from buildings shall be removed from the Project site as required by the OAR.
- D. Trenches outside of barricade limits shall be backfilled and paved within 24 hours after being inspected by the Inspector. Provide traffic plates during the time that trenches are open in traffic areas and in areas accessible to students and staff.
- E. Where existing structural walls are cored for new conduit runs, separation between cored holes shall be three inches edge to edge from new or existing holes, unless otherwise required by the Architect. All coring to be laid out and reviewed by Architect prior to drilling. CONTRACTOR to verify location of structural steel, rebar, stress cabling or similar prior to lay out.
- F. Electrical equipment shall be braced and anchored for CBC Seismic Design requirements, or as otherwise indicated on the Drawings.

3.02 DELIVERY STORAGE AND HANDLING

- A. Deliver products to project site with proper identification, which shall include names, model numbers, types, grades, compliance labels, and similar information needed for District

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identification; all products and materials shall be adequately packaged and protected to prevent damage during shipment, storage, and handling.

- B. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion.

3.03 CUTTING AND PATCHING

- A. Cutting and patching of electrical equipment, components, and materials shall include the removal and legal disposal of selected materials, components, and equipment.
- B. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- C. Repair or restore other work or surfaces damaged as a result of the work performed under this contract.

3.04 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose off the Project site.
- B. Remove equipment and implements of service, and leave entire work area neat and clean, to the satisfaction of the Owner Authorized Representative (OAR).

3.05 PROTECTION

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

END OF SECTION

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SECTION 26 0513 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Boxes, enclosures, keys and locks.S
2. Receptacles and switches.
3. Identifications and signs.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Division 26 – Electrical.
3. Division 27 – Communications.
4. Division 28 - Electronic Safety and Security.

PART 2 - PRODUCTS

2.01 BOXES, ENCLOSURES, KEYS AND LOCKS

A. Outlet Boxes and Fittings:

1. Outlet boxes installed in concealed Work shall be galvanized steel, pressed, or welded type, with knockouts.
2. In exposed Work, where conduit runs change direction or size, outlet boxes and conduit fittings shall be cast metal with threaded hubs cast integral with box or fitting.
3. Fittings shall be cast metal and non-corrosive. Ferrous metal fittings shall be cadmium-plated, or zinc galvanized. Castings shall be true to pattern, smooth, straight, with even edges and corners, of uniform thickness of metal, and shall be free of cracks, gas holes, flaws, excessive shrinkage, and burnt-out sand.
4. Covers for fittings shall be galvanized steel or non-corrosive aluminum and shall be designed for particular fitting installed.

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5. Light fixture outlets shall be 4-inch octagon, 4-inch square, 2 1/8-inch deep or larger, depending upon number of conductors or conduits therein. Plaster rings shall be furnished with round opening with two ears drilled 2 23/32 inches center to center.
6. For local device outlets provide 4-inch square 2 1/8-inch deep, boxes for single gang, 5-inch square boxes for two-gang, and special solid gang boxes with gang plaster ring for more than two switches.
7. For TV outlets, and horns and strobes provide manufacturer's supplied back box as needed. For television outlets, provide 4-gang deep boxes and 4-gang plaster rings.
8. Plaster rings shall be provided on flush-mounted outlet boxes except where otherwise indicated or specified. Plaster rings shall be same depth as finished surface. Install approved ring extension to obtain depth to finish surface.
9. In existing plywood wall or drywall construction, and where flexible steel conduit is fished into walls, single-gang and 2-gang outlets for wiring devices may be sectional steel boxes with plaster ears. Boxes shall be fastened to plywood with flat-head screws in each plaster ear screw hole. Boxes fastened to gypsum board shall be Raco, Appleton, Cooper, Bowers, or equal.
10. Factory made knockout seals shall be installed to seal box knockouts, which are not intact.
11. Where flexible conduit is extended from flush outlet boxes, provide and install weatherproof universal box extension adapters.

B. Junction and Pull boxes:

1. Junction and pull boxes, in addition to those indicated, shall only be used in compliance with codes, recognized standards, and Contract Documents.
2. Interior and non-weatherproof boxes shall be constructed of blue or galvanized steel with ample laps, spot welded, and shall be rigid under torsion and deflecting forces. Boxes shall be furnished with auxiliary angle iron framing where necessary to ensure rigidity.
3. Covers shall be fastened to box with enough machine screws to ensure continuous contact all around. Flush type boxes shall be drilled and tapped for cover screws if boxes are not installed plumb. Surfaces of pull and junction boxes and covers shall be labeled in black marker ink designating system, panelboard and circuit designation contained in box. In exposed Work, designation shall be installed on inside of pullbox or junction box cover.

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4. Weatherproof NEMA 3R pull and junction boxes shall conform to foregoing for interior boxes with following modifications:
 - a. Cover of flush mounting boxes shall be furnished with a weather-tight gasket cemented to, and trimmed even with, cover all around.
 - b. Surface or semi-flush mounting pull and junction boxes shall be UL, or another Nationally Recognized Testing Laboratory (NRTL) listed as rain-tight and shall be furnished complete with threaded conduit hubs.
 - c. Exposed portions of boxes shall be galvanized and finished with one prime coat and one coat of baked-on gray enamel, unless already furnished with factory baked-on finish.
5. Junction and pull boxes shall be rigidly fastened to structure and shall not depend on conduits for support.
6. Underground Concrete Pull Boxes:
 - a. Pre-cast concrete pull boxes. Concrete pull boxes shall be traffic type, reinforced for H-20 wheel loading, pre-cast concrete. Pull boxes with inside dimensions of 2 feet by 3 feet by 3 feet deep shall consist of a base section, top ring, and cover. Base section shall be furnished with 2 knockouts measuring 10 inches by 10 inches in each 3 feet side, and one 20 inches by 20 inches knockout in each 2-foot side. Pull boxes with inside dimension 4 feet by 4 feet by 4 feet deep shall consist of a base section, midsection, topping, and cover. Base section shall be furnished with 2 knockouts measuring 8-inch by 16-inch on each of two opposite sides, and one 20-inch by 20-inch knockout on each of other two opposite sides. Pull boxes shall be furnished with a minimum of 6-inch diameter sump knockout and one-inch diameter ground rod knockout. In pull boxes, furnish and install cable racks on walls. Racks shall be furnished with 3 porcelain cable holders on vertical steel mounting bars. Pull boxes shall be furnished with 3/4-inch diameter pull irons. Covers shall be traffic-type consisting of steel safety plate bolted to frame. Covers shall be marked as electrical, power, or signal as required.
 - b. Provide end bells in duct entrances. Terminate each metal conduit with insulated bushing provided with a grounding terminal.
 - c. Install pulling irons on opposite walls and below horizontal centerlines of ducts and bricked-up openings, and in bottom. Install pulling irons with each end hooked around a reinforcing bar.

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- d. Remove floor drain knockout and provide a depth of 24 inches of crushed rock below box extending a minimum of 12 inches beyond on all sides.
 - e. Permanently and effectively ground metal equipment cases, cable racks, and similar items in pull boxes to site grounding electrode system. Provide grounding conductor in compliance with CEC Article 250.
 - f. Provide 6-inch deep sand base under pull boxes.
 - g. Identify power and signal cables by tagging in manholes and pull boxes. Tie securely to cables with nylon cord.
 - h. Top of steel plate shall provide a minimum coefficient of static friction of 0.5 for either wet or dry locations, when tested for any shoe sole material. Test shall comply with ASTM D 1047 or F 489 or F 609 standards. Submit manufacturer's test results for Architect's review as part of materials and equipment submittals.
 - i. The use of underground extension boxes shall be limited to not more than 1 times the original depth of pull box.
 - j. Approved Products: Oldcastle Precast, Jensen Precast, Kistner, Western Precast, or OWNER approved equal.
7. Underground utility boxes shall be reinforced concrete with non-setting shoulders to prevent settlement following installation. Boxes shall be furnished with cast iron cover with finger hole, size as indicated on Drawings. Utility boxes shall be as manufactured by Oldcastle, Jensen, Kistner, Western Precast, or equal.
8. Manholes, vaults, and pull boxes required by a utility company, and installed as part of this Contract, shall meet requirements of servicing utility company.
- C. Floor Outlets:
- 1. Floor Outlets (except for extension outlets) shall be cast iron, watertight floor boxes with flush brass floor plates, and shall be set to finish flush with finish floor covering, whether it be carpeted, wood, resilient floor covering, or other finish materials.
 - a. Floor boxes shall be used in offices, classrooms, areas only.
 - b. Approved Products: Harvey Hubbell Inc. B-2503, Thomas & Betts 640 series, Legrand Omnibox, or OWNER approved equal.

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2. Telephones above floor outlets, where not subject to water, shall be provided with Harvey Hubbell Inc. SC-3098 pedestals with SC309T plates. Refer to other Division 26 sections. Floor boxes shall be used in offices, classrooms and in Library areas only.
 - a. Approved Products: Legrand 525 series, Thomas & Betts FPT-400 Series, or OWNER approved equal
 3. Plugs above floor outlets where not subject to water shall be provided with pedestals and device plates. Refer to other Division 26 sections. Floor boxes shall be used in offices, classrooms, and library areas only.
 - a. Approved products: Pedestals shall be Legrand 525 series, Thomas & Betts FPT-400 Series, Harvey Hubbell Inc. SC-3098; Device plates shall be Hubbell SS309D, or District approved equal.
 4. Two gang and single box pedestal boxes shall be listed for wet locations where subject to water. Provide required cover plates.
 - a. Floor outlets shall be used in any areas where floors are subjected to water.
 - b. Approved products: Single gang boxes - Hubbell SA-6687. Two gang boxes shall be Hubbell SA-6885, or OWNER approved equal.
 5. Extension floor outlets shall be cast iron with cast iron covers, and 1/2-inch offset entries for above-floor conduit extensions; Boxes shall be designed to permit access to wiring without disturbing above-floor extensions and shall be set flush with finish floor.
 6. Above floor service fittings for data outlets and surge suppression receptacles shall be faceplate interchangeable, die cast aluminum.
 - a. Approved products: Hubbell SC3098 with cover plates SS309DS, Legrand 525 series, Thomas & Betts FPT-400 Series, or OWNER approved equal.
- D. Floor Pockets – Plugging Boxes:
1. Three-Gang floor lighting pockets shall be flush floor type recess floor mounted enclosure, with cast iron floor plate and hinged cast iron door notched for cables.
 - a. Each floor pocket shall be provided with three 20-amp, 3 wire, 125-volt receptacles with matching caps.

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- b. Approved products: Legrand or Hubbell Recessed Floor Boxes, C.W. Cole TLS 353-6, or equal, for wood floors and C.W. Cole TLS-353-6-C, or OWNER approved equal for concrete slabs.

2. Single Gang:

- a. Receptacle floor pockets shall be single gang, flush floor type, with cast iron floor plate, hinged cast iron door notched for cable and cast-iron box. Provide each pocket with a standard, single grounding type receptacle unless otherwise indicated.

- 1) Approved Products: C.W. Cole TLA-362-1-FE, or OWNER approved Legrand or Hubbell recessed floor box, or OWNER approved equal. For wood floors provide C.W. Cole TLS-362-1, or OWNER approved equal.

- b. Microphone or projector floor pockets shall be single gang flush floor type with cast iron floor plate, hinged cast iron door, notched for cable and cast-iron box.

- 1) Approved Products: Legrand or Hubbell recessed floor box, C.W. Cole TLA-362-3-FE, C.W. Cole TLS-362-3, in wood floors, or OWNER approved equal.

E. Keys and Locks:

- 1. Provide two keys with furnished door locks, including cabinet door locks and switchboard locks, two keys for lock switches on switchboards or control panels, and two keys with interlocks or other furnished lock switches. Deliver keys to OAR.
- 2. Special keys and locks shall only be provided where specified. Locks shall be keyed to Corbin No. 60 or 70 as follows:
 - a. Access to operate equipment shall be keyed to Corbin 60.
 - b. Access to service areas shall be keyed to Corbin 70.

2.02 RECEPTACLES AND SWITCHES

A. Receptacles:

- 1. Duplex receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be wired on the side and back with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction.

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Receptacle back body shall be PVC. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall have triple wipe brass power contacts.

a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
(20 amps) NEMA 5-20	PS5362-I	HBL5362-I	5362-I
(15 amps) NEMA 5-15	PS5262-I	HBL5262-I	5262-I

Equal products approved by OWNER may be acceptable.

2. Duplex receptacles on circuits supplied by panel boards with integral surge suppression shall be Pass & Seymour model number PS5262BL (blue), Hubbell DRUBTVSS15, Leviton 5262-SBU, 15-amps, 120-volts, or OWNER approved equal.
3. Single receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be back and side wire with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be thermoplastic. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall have triple wipe brass power contacts. For circuits consisting of one single receptacle only, ampere rating of receptacle shall be same as circuit breaker or fuse.

a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
(20 amps) NEMA 5-20R	5361-I	HBL5361-I	5361-I
(15 amps) NEMA 5-15R	5261-I	HBL5261-I	5261-I

Equal products approved by OWNER may be acceptable.

4. Single 15 and 20-amps receptacles on circuits supplied by panel boards with integral surge suppression shall be blue in color.
 - a. Approved products: Pass & Seymour NEMA 5-20R model number 5361-BL (blue), NEMA 5-15R model number 5261-BL (blue), or OWNER approved equal.
5. Kiln and range receptacles, provide 3-pole, 4-wire, grounding type, rated 50 amps or as indicated on plans. Receptacle shall be rated 125/250 volts NEMA 14-50R. Provide 2-gang, stainless steel plates.

a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 14-50R	3894	HBL9450A	279
WALL PLATE	SS703	S703	84026

Equal products approved by OWNER may be acceptable.

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6. Dryer receptacles. Provide 3-wire, non-grounding type, rated 30 amps at 125/250 volts, NEMA 10-30R, with 2-gang stainless steel plates. Coordinate location of junction box with the work of Section 10 2815, Hand and Hair Dryers.

a. Approved Products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 10-30R	3860	HBL9350	5207
<u>WALL PLATE</u>	SS703	S703	84026

Equal products approved by OWNER may be acceptable.

7. Provide specification grade ground-fault circuit interrupter (GFCI) type receptacles in accordance with 2010 UL standards. GFCI receptacles shall have a trip indication light. Receptacle terminal screws shall be back and side wire with internal screw pressure plates. Test and reset buttons shall match device body and shall be ivory. GFCI receptacles shall be manufactured in standard configuration for installation with stainless steel smooth plates. Exterior mounted receptacles shall be mounted inside weatherproof enclosure.

a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 5-20R	2095-I	GFR5352-IA	7899-I
NEMA 5-15R	1595-I	GFR5252-IA	8598-I

Equal products approved by OWNER may be acceptable.

8. Provide weatherproof receptacles, except where otherwise indicated or specified, consisting of GFCI receptacles, as specified herein, and metal plates with die-cast lockable hinged lids and weatherproof mats;

Tamper-resistant receptacles with thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects. Receptacles shall have extra heavy-duty brass, one-piece mounting strap with integral ground. Receptacles shall be ivory color, impact resistant nylon face and back body.

a. Approved products:

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Arrow Hart</u>	<u>Leviton</u>
NEMA 5-20R	TR63-I	TR8300V	8300SGI
NEMA 5-15R	TR62-I	TR8200V	8200SGI

Equal products approved by OWNER may be acceptable.

9. Provide transient voltage surge suppression (TVSS) receptacles offering metal oxide varistors (MOVs) protecting normal and common modes, (L-N, L-G, N-G) with 500V suppressed voltage. TVSS devices shall offer 3-mode equal protection with 210 joules minimum per mode of energy absorption and 13,000-amp maximum surge capability. TVSS devices shall have 3 thermal fuses and

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two over-current protection fuses. TVSS devices shall have LED visual only surge status indicator to alert user to surge suppression circuit condition. Visual indicator will be illuminated (red) when power is on and surge suppression circuit is fully functional. Visual indicator will not be illuminated when power is off or unit experiences loss of surge suppression protection. Terminals shall be back and side wire including ground terminal. Color shall be blue.

a. Approved Products

<u>NEMA #</u>	<u>Pass& Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 5-20R	5352BLSP	HBL5360SA	5380B
NEMA 5-15R	5252BLSP	HBL5260SA	5280B

Equal products approved by OWNER may be acceptable.

B. Switches

1. Local Switches:

a. Local switches shall be high strength thermoplastic toggle, industrial grade, rated 20 amps at 120-277 volts AC only, with plaster ears, external screw pressure plate back and side wired, and standard size composition cups which fully enclose mechanism. Switches shall be approved for installation at currents up to full rating on resistive, inductive, tungsten filament lamp and fluorescent lamp loads, and for up to 80 percent of rating for motor loads. Switches shall have oversized silver alloy contacts for long life and better heat dissipation. Provide switches as single pole, double pole, 3-way, 4-way, non-lock type. Provide non-lock type switches with ivory handles;

	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
Single pole	PS20AC1I	HBL1221I	1221-2I
Double pole	PS20AC2I	HBL1222I	1222-2I
Three-way	PS20AC3I	HBL1223I	1223-2I
Four-way	PS20AC4I	HBL1224I	1224-2I

Equal products approved by OWNER may be acceptable.

b. Lock type switches shall be specification industrial grade, 20 amp, 120-277 volts with metal or nylon key guides with on/off indication, and operable by same key. Key shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16-inch long forks, 5/32-inch spacing between forks and 5/16-inch width overall.

1) Approved products:

	<u>Pass & Seymour</u>	<u>Arrow Hart</u>
Single pole	PS20AC1L w/#500 Key-2L	1221L w/1201LK Key
Double pole	PS20AC2Lw/#500 Key	1222L w/1201LK Key

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Three-way PS20AC3L w/#500 Key 1223L w/1201LK Key
Four Way PS20AC4L w/#500 Key 1224L w/1201LK Key
Equal products approved by OWNER may be acceptable.

- c. Rotary lock switches shall incorporate a tumbler type lock to prevent unauthorized operation. Lock shall be tumbler type by Corbin, keyed to a HH41 key. Lock switch to be installed with pin tumblers facing downward. Key shall be removable in all positions. Each device shall be complete with 2 keys. Keys shall be delivered only to the OAR. Switches shall be rated at 20 amps, 120-volt or 277-volt AC. Switch plates shall be of stainless steel, engraved with on and off positions indicated.

- 1) Approved products:

Arrow Hart
Single pole AH1191N
Double pole AH1192N
Three-way AH1193N
Equal products approved by OWNER may be acceptable.

- d. Pilot light switches shall be rated 20 amps and shall conform to specifications for local switches. Switches shall be furnished with red, Lexan handles that are lighted by LED lamps. Pilot light shall light when load is on. Pilot light 120-volt switches

- 1) Approved products:

	<u>Pass& Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
Single pole	PS20AC1-RPL	HBL1221-PL	1221-PLR
Double pole	PS20AC2-RPL	HBL1222-PL	1222-PLR
Three-way	PS20AC3-RPL	HBL1223-PL	1223-PLR

Equal products approved by OWNER may be acceptable.

- 2) 20 amps, 277 volts rated pilot light switches shall be single pole and shall conform to specifications for local switches, and the requirements of paragraph d above.

- a) Approved Products:

<u>Pass & Seymour</u>	<u>Leviton</u>	<u>Hubbell</u>
PS20AC1-RPL	1221-7PR	HBL1221-PL7

- e. Provide remote control switches for mechanically held contactors arranged for 3-wire control, toggle type, momentary contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclose mechanism, and ivory handles.

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- 1) Approved products:

<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
1251-I	HBL1557-I	1285-I

Equal products approved by OWNER may be acceptable.

- f. Provide remote control switches for magnetically held contactors arranged for 3-wire control, toggle type, maintained contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclosed mechanism, and ivory handles.

- 1) Approved products:

<u>Pass and Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
1225-I	HBL 1385	1285-I

Equal products approved by OWNER may be acceptable.

- g. Momentary Contact locking key type switch. 20A 120/277V center off. Key shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/32" spacing between forks and 5/16" width overall.

- 1) Approved products:

Arrow Hart AH1995L w/ AH2000 key

Equal products approved by OWNER may be acceptable.

- h. Momentary Contact switch low voltage 1 pole 3A 24VAC 3 position center off. Key for locking switch shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/31" spacing between forks and 5/16" width overall.

- 1) Approved products:

Pass and Seymour Toggle 1081I, Locking 1081KGRY w/#500 Key

Equal products approved by OWNER may be acceptable.

2. Time Switches and Photoelectric Controls.

- a. Provide time switches with a 7-day, solid-state, electronic type capable of fully automatic or manual operation and housed in a sheet steel enclosure unless built into a panel or switchboard. Resistive or inductive contacts rated for 25-amps, each pole 240-VAC; 5-amps tungsten or 277-VAC pilot duty, each pole 240-VAC. Time switches to contain a non-volatile clock and non-volatile memory with a built-in rechargeable super capacitor power carry-over system. Battery carryover is not

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acceptable. Provide a minimum of 15 on/off set points per week. Timing to be in one-minute increments with a minimum on or off time of one minute. Time switch digital displays to indicate days of week, hours, and minutes. Display to contain a load status light to indicate when equipment is in operation.

b. Required :

- 1) Liquid crystal display panel.
- 2) Holiday scheduling: Up to 40 dates may be assigned special holiday schedules, up to one year in advance.
- 3) Automatically adjusts to and from daylight savings time and for leap year.
- 4) Contact ratings: 10 amp at 240 VAC.
- 5) Safety override switch for each circuit to either provide shut down of circuit or to override on.
- 6) Selective review: All or part of schedule shall be displayed at touch of a key.
- 7) Super Capacitor for power carry-over system.
- 8) Supply voltage: 120/277-Volt.
- 9) 365-day advance scheduling.

c. Approved products: Tork Model EW 101B series, Intermatic ET90000 series, or OWNER approved equal.

d. Photoelectric control: Shall be rated 2,000 watts, 120V with single pole, single throw, normally closed contact, enclosed in a die-cast aluminum gasketed enclosure with 1/2-inch conduit fitting,

- 1) Approved products: Tork series 2100, or OWNER approved equal.

3. Emergency Lighting Control Unit

a. The Emergency Lighting Control Unit shall provide all required functionality to allow a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.

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- b. The emergency lighting control unit shall allow control of emergency lighting fixture in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power supplying the control device. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.
- c. The device shall have normally closed dry contacts capable of switching 10-amp emergency ballast loads at 120-277 VAC, 60 Hz., 2-amp tungsten loads at 120 VAC, 60Hz., LED loads at 120-277V VAC, 60 Hz
- d. The device shall have universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.
- e. The device shall provide separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency)
- f. The device's normal power input terminal shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.
- g. The unit shall automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
- h. Approved products: WattStopper ELCU-100 Emergency Lighting Control Unit, LVS #EPC-PM Series, Lighting Control Design #GR 2001 series, or OWNER approved equal.

2.03 IDENTIFICATION AND SIGNS

A. Identification Plates:

- 1. Provide identification plates for the following unless otherwise specified, for switchboards, unit substations, motor control centers, control panels, push-button stations, time switches, contactors, motor starters, motor switches, panelboards, and terminal cabinets.
- 2. Identification plates shall be of plastic stock and shall adequately describe function, voltage and phase of identified equipment. Where identification plates are detailed or described on Drawings, inscription and size of letters shall be as indicated. For lighting and power panels, identification plates shall indicate

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panel designation, voltage, and phase of panel. For terminal cabinets, identification plates shall indicate system contained in terminal cabinet.

3. Identification plates shall be black-and-white nameplate stock of bakelite with characters cut through black exposing white. Plates shall be furnished with beveled edges and shall be securely fastened in place with No. 4 Phillips-head, cadmium-plated steel, self-tapping screws. Characters shall be 3/16 inch high, unless otherwise indicated.

B. Markings:

1. Install identification markings to surface-mounted starters, switches, disconnect switches, contactors, and other devices controlling motors and appliances. Provide abbreviations required along with an identifying number. Markings to be provided with locking type stencils using paint of a contrasting color. Figures shall be 3/8 inch high unless otherwise indicated. Dymo Industries Inc., self-sticking plastic labels, with embossed characters made with a typewriter may be installed instead of stencils and paint; p-touch self adhesive plastic, or Brother P-Touch self sticking laminated plastic labels may be installed.
2. High Voltage: High voltage switchboards, cabinets, boxes, and conduits exposed in accessible locations, including under buildings and in attics, are required to be marked "WARNING-HIGH VOLTAGE – ABOVE 600 VOLTS". Markings for switchboards shall consist of 18 gage steel, porcelain enamel sign of standard manufacture. Markings for boxes, cabinets, and conduits shall be by means of stenciling or printed self-adhesive markers, Westline Tel-A-Pipe, or equal. Provide letters of black on orange background and not less than 1-7/8 inches high. On conduit runs, install markings at intervals not exceeding 10 feet in any individual area. Markings shall be installed after other painting Work is complete.

C. Warning Signs:

1. Provide a warning sign on outside of each door or gate to rooms or enclosures containing high voltage equipment. Signs required reading, "WARNING - HIGH VOLTAGE - KEEP OUT". Provide 2-inch high lettering.
2. Provide a warning sign on each high-voltage non-load break disconnect and fused cutout (not oil filled). Signs required reading, "DO NOT OPEN UNDER LOAD". Provide 2-inch-high lettering.
3. Provide signs of standard manufacture, 18 gage steel, with porcelain enamel finish. Provide red lettering on a white background.

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3.01 INSTALLATION AND SUPPORT OF BOXES

- A. Install outlet boxes flush with finished surface of wall or ceiling. Install plumb and securely fastened to structure, independent of conduit. Except where otherwise indicated, provide factory-fabricated adjustable attachment bar hangers between studs to support outlet boxes. When installation is performed in fire rated walls, maintain the wall's rating integrity by means of approved fire stop methods.
- B. Outlet boxes installed in suspended or furred ceilings with steel runner or furring channels shall be supported, except where otherwise indicated, by a Unistrut P-4000 Tessco A1200HS-10, Cooper B-Line B22s-HG, or OWNER approved equal channel spanning main ceiling runner channels. Each box shall be supported from its channel by a 3/8-inch 16 threaded steel rod with a Unistrut P-4008, Fastenal #48604, Copper B-Line 78101140346 or OWNER approved equal; nut and a Tomic No. 711-B Adapta-Stud, or OWNER approved equal. Rod shall be tightened to a jamb fit with channel and its nut. Box shall be locked to rod by means of a 1/2-inch locknut on stud and a 3/8-inch 16 hex nut locking stud to rod.
- C. Heights of outlets and equipment indicated on Drawings shall govern. In absence of such indications, following heights shall be maintained with heights measured to centerline unless otherwise noted:
 - 1. Install wall-mounted switches at 48 inches above finished floor.
 - 2. Outlet boxes for fire alarm pull stations shall be mounted at a mounting height above finished floor that ensures that the operating handle of the initiating device is no higher than 48 inches from finished floor.
 - 3. Wall mounted fire alarm strobe or horn/strobe devices shall be mounted such that the entire lens is not less than 80 inches above finished floor. If ceiling heights allow, wall mounted appliances shall have bottom of lens a minimum of 80 inches but not more than 96 inches to the top of lens.
 - 4. Install outdoor fire alarm audible devices or fire alarm sprinkler flow bells at least 10 feet but not more than 12 feet above finished floor to center. Provide STI or other OWNER approved protective covers as required in plans.
 - 5. Voice evacuation speakers mounted indoors shall be mounted in ceiling space or if mounted on wall shall not be less than 10 feet to center above finished floor.
 - 6. Install clocks and speakers, in classrooms and offices, 7'-6" feet above finished floor. Unless otherwise indicated.
 - 7. In rooms other than places of assembly such as, but not limited to, multipurpose rooms, auditoriums, and libraries, clock outlets and speakers in classrooms and

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offices shall be mounted 8 feet above finished floors. Other assembly areas such as gymnasiums shall be mounted 10 to 12 feet above finished floor. Provide STI, or equal protective covers for clocks when required.

8. Install fire alarm strobe lights 80 inches to bottom of light above finished floor.
9. Install outside bells and yard light outlets 4 feet above second floor level for 2 or more story buildings, 12 inches below top plate level for one story buildings without covered porch or arcade, and 12 inches below covered porch and arcade ceilings.
10. Install desk telephones, power receptacle outlets, and data outlets 15 inches above finished floor.
11. Install panelboards and terminal cabinets 6 feet 6 inches from finish floor to top of cabinet.
12. Install television outlets at a height corresponding to location of television monitor, or as indicated on plans.
13. The use of extension boxes shall be limited to not more than 1 times the original depth of junction box.

3.02 COVER PLATES

- A. Provide a plate on each switch, plug, pilot light, data, interphone, public telephone, and television outlet, and on existing and reset outlets where so indicated or required. Plates shall be of stainless steel unless otherwise specified.
- B. Flush wiring device and signal system outlets indicated to be blank covered, shall be covered with blank stainless-steel plates. Flush lighting outlets to be blanked shall be covered with Wiremold 5736 steel covers, or equal, painted to match surrounding finish. Provide stainless steel covers to blank indicated or required surface-mounted outlets.
- C. In the following cases, and at required locations. Switch and receptacle plates shall be engraved with the device(s), or fixtures being controlled, or as indicated:
 1. Three-gang and larger gang switches in locations other than classrooms.
 2. Lock switches.
 3. Pilot switches.
 4. Switches so located that operator cannot see fixtures, or items of equipment controlled while his hand is on the switch.

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5. Switches not in same room with fixtures or items of unit heaters, air curtains, fly fans, etcetera.
 6. Receptacles operating at other than 120 V shall be identified with the operating voltage.
 7. Switches operating on 277 V shall be identified with the operating voltage.
 8. Where indicated on Drawings.
- D. Designations shall be as indicated on Drawings or as specified by Architect.
- E. Standard GFI cover plates shall be Pass & Seymour 4600, Raco 5028-0, or equal. GFI cover plates shall be provided with a CAM lock mechanism with two keys or a padlock hasp that does not protrude through the face of the cover and will allow the shank of locks keyed Corbin No. 60 keys.

3.03 IDENTIFICATION OF CIRCUITS AND EQUIPMENT

- A. Provide descriptive nameplates or tags permanently attached to switchboards, motor control centers, transformers, panelboards, circuit breakers, disconnect switches, starters, pushbutton control stations and other apparatus installed for operation or control of circuits, appliances, fire alarm control panel(s), fire alarm annunciator(s), power supplies, terminal cabinets, energy management control units, and Information technology system backbone and distribution equipment points.
- B. Provide nameplates of engraved laminated plastic, or etched metal. Submit Shop Drawings denoting dimensions and format to Architect before installation. Fasten to equipment with escutcheon pins, rivets, self-tapping screws, or machine screws. Self-adhering or adhesive backed nameplates are not permitted.
- C. Fasten tags to feeder wiring in conduits at every point where runs are broken or terminated, including pull wires in empty conduits. Indicate circuit, phase, and function. Tag branch circuits in panel boards and motor control centers. Tags may be manufactured of pressure-sensitive plastic or embossed self-attached stainless steel or brass ribbon.
- D. Provide circuit identification cards and cardholders in all panel boards. Cardholders shall consist of metal frame retaining a clear plastic cover permanently attached to inside of panel door. List of circuits shall be typewritten on a card. Circuit description shall include name or number of circuit's area and connected load.
- E. Junction and pull boxes shall have covers stenciled with box number when indicated on Drawings, or circuit numbers according to panel schedules. Data shall be lettered in a conspicuous manner with a color contrasting with finish.

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- F. Name shall be correctly engraved, with a legend indicating function or areas, when required by codes or indicated on Drawings.

3.04 PROTECTION

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

3.05 CLEANUP

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

END OF SECTION

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SECTION 26 05 16 - MEDIUM-VOLTAGE CABLES, SPLICES AND TERMINATIONS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section specifies the furnishing, installation, and connection of medium-voltage cables, indicated as cable or cables in this section, and medium-voltage cable splices and terminations.
- B. Single conductor 15,000 volt shielded copper power cable insulated with ozone and discharge resistant flexible, rubber like thermosetting dielectric for medium-voltage applications, suitable for use in wet and dry locations in conduit and underground ducts.
- C. Related Requirements:
 - 1. Division 01 – General Requirements.
 - 2. Section 26 05 00 – Common Works Results for Electrical.
 - 3. Section 26 05 13 – Basic Electrical Materials and Methods.
 - 4. Section 26 05 26 – Grounding and Bonding.
 - 5. Section 26 08 00 – Electrical Systems Commissioning.
 - 6. Section 26 12 00 – Medium Voltage Transformer.
 - 7. Section 26 13 16 – Medium Voltage Metal Enclosed Load Interrupter.
- D. Applicable Standards. The most current version of the standard applies:
 - 1. ANSI C84.1 – Electric Power Systems and Equipment - Voltage Ratings (60 Hertz).
 - 2. ANSI/ICEA S97-682 – Standard for Utility Shielded Power Cables Rated 5 through 46 KV.
 - 3. ANSI/ICEA S97-649 – Concentric Neutral Cables Rated 5 Through 46 KV.
 - 4. California Electrical Code.
 - 5. IEEE 48 – Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated

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Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV

6. IEEE 141 – Recommended Practice for Electric Power Distribution for Industrial Plants.
7. IEEE 242 – IEEE Protection and Coordination of Industrial and Commercial Power Systems.
8. IEEE – Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 KV Through 35 KV.
9. IEEE 404 – Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2.5 kV to 500 kV.
10. UL 1072 – Standard for Medium-Voltage Power Cables.

1.02 SUBMITTALS

- A. Provide submittals in accordance with Division 01.
- B. Submit layout drawings and diagrams of cabling system configuration for Architect/Engineer's review.
- C. Submit three 36 inches long pieces of the proposed cable for OWNER's inspection, evaluation and approval.
- D. Submit manufacturer's cut sheets and description of products' components.
- E. Submit a third-party certified test report per The Association of Edison Illuminating Companies (AEIC) CS-8 from the factory to the Project Inspector, and Architect/Engineer before installation, for each length of cable delivered to the Project site. This report shall certify compliance with the requirements of Insulated Cable Engineers Association (ICEA); the report shall include all required test data.
- F. High voltage cable shall not be installed until cable and test report have been reviewed by the Architect/Engineer. Submit five copies of the report.

1.03 QUALITY ASSURANCE

- G. The cable manufacturer shall have a minimum of 15 years manufacturing EPR insulated cables.
- H. Cables shall be tested for corona discharge and shall comply with AEIC requirements. A copy of the original x-y plot showing discharge levels shall be

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included as part of the certified test reports. Submit test report for Architect/Engineer and Project's Inspector review prior to installation.

- I. Tests shall be performed in accordance with (NETA Specification) ANSI/ICEA S-97-682, S-97-649 and UL Standard 1072; the tests could be performed by a UL or another approved equal Nationally Recognized Testing Laboratory (NRTL).
- J. CONTRACTOR shall ensure that applicable sections of IEEE standards 141 and 242 are followed in the evaluation and installation.
- K. Reels of furnished cable shall be newly manufactured of not more than 12 months old, and shall bear tags containing name of manufacturer, CEC designation, and year of manufacture.

1.04 WARRANTY

- A. The following warranties are required:
 - 1. Five-year material warranty from the manufacturer.
 - 2. Two-year installation.

PART 2 - PRODUCTS

2.01 CABLE

- A. Cables shall be insulated, shielded and jacketed, and shall be listed for wet and dry locations, sunlight resistant, and for cable tray and conduit use.
- B. Medium-voltage cable shall be furnished where line-to-line operating voltage exceeds 600 volts.
- C. Cables shall be 15 KV, single conductor, 133 percent insulation rating, ethylene propylene rubber insulated, shielded, PVC jacket Type MV-105.
- D. Conductors shall be Class B stranded annealed, uncoated copper.
- E. Insulation system conductor screens, insulation and insulation screens shall be capable of continuous operation at conductor temperatures of 120° Centigrade, and emergency overload temperatures of 140 degrees C.
- F. Cables shall be identified indicating manufacturer, size, insulation type, voltage rating, year manufactured, and UL, or other Nationally Recognized Testing Laboratory designations.

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PART 3 - EXECUTION

3.01 CABLE INSTALLATION

- A. Installation of cable, including joints, splices, taps, bends, connections, terminations, and method of pulling cable into conduit shall be performed in accordance with manufacturer's recommendations.
- B. In manholes, handholes and vaults CONTRACTOR shall provide cable(s) loop(s) to allow for future splicing and extensions. Cables shall be wrapped in fireproofing tape and properly supported per applicable codes and standards.
- C. Stress cones shall be installed on cable at joints, splices, and terminations as recommended by the cable manufacturer and industry standards; the most stringent shall apply. Minimum bending radius of cable shall be in strict accordance with manufacturer's recommendations.
- D. Cable splicing shall be performed by a Certified Cable Splicer with minimum experience of five years, CONTRACTOR shall provide copy of Cable Splicer employee certification.
- E. Use only environmentally safe pulling compound, approved by the OWNER'S Office of Environmental Health and Safety.
- F. Cables shall be identified (labeled) at points of termination and points where conduit run is broken, as to phase leg and feeder designation. This requirement applies at man-holes, switchboards, pull boxes, and like items. Markers shall be E-Z Code, Brady Perma-Code, or equal. ID tags shall be water proof and one inch in size.
- G. Each cable shall be subjected to a high potential DC test in the presence of the Inspector, Architect/Engineer, and Commissioning Agent. CONTRACTOR shall provide no less than two working days' notice of proposed time for test. Hi-Pot test shall be NETA Acceptance Values.
 - 1. Test shall be performed with equipment specifically designed for this type of test and in a manner recommended by cable manufacturer. Copies of test report shall be submitted to the Architect/Engineer for review.
 - 2. Test voltage shall be raised gradually in steps to final voltage recommended by ICEA, which shall be applied for five minutes. Current readings shall be taken at each step after leakage current has stabilized and readings shall be plotted on graph paper. If breakdown is indicated during test by a sudden increase in current, discontinue tests and provide replacements necessary to correct defective Work.

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- H. Cables not meeting test minimum requirements shall be replaced with new. Segmented replacement is not acceptable. Perform splices and terminations necessary for replacement of cable(s). Replace splices and terminations where test results indicate to be defective Work.

3.02 CABLE TERMINATIONS

- A. Provide termination kits capable of proper termination of 15 KV class single conductor cables. Kits shall meet Class I requirements and be design proof tested in accordance with IEEE 48. Kits shall accommodate common forms of cable shielding and construction without the need for special adapters or accessories, and shall accommodate a range of cable sizes. Kits shall be capable of proper installation on out-of-round cable in accordance with ICEA and AEIC standards. Kits shall accommodate commercially available environmentally sealed connectors.
- B. Terminations for single conductor shielded cables shall consist of heat shrinkable stress control and other required non-tracking insulation tubing or tapes. Kits shall also contain high relative permittivity stress relief mastic for insulation shield cutback treatment with a heat-activated sealant for environmental sealing.
- C. Cable Terminator(s) shall demonstrate actual field experience and suitable accelerated and real-time testing of weathering resistance. Test reports, which verify device stability with time, temperature, and electrical stress variations, shall be submitted for review.

3.03 CABLE SPLICES

- A. Splices shall be factory engineered kits that rebuild the cable insulation to that of the cable. Splices shall contain necessary components to reinstate the cable's primary insulation, metallic shielding and grounding systems, and an outer jacket.
- B. Splices shall be capable of passing the electrical test requirements of IEEE-404 and water immersion tests of ANSI/IEEE 386.
- C. Splices shall be of uniform cross-section, heat shrinkable polymeric construction utilizing an impedance layer stress control tube and high dielectric strength insulating layers. Outer insulating layer shall be bonded to a conducting layer for shielding. The splice shall be re-jacketed with a heat shrinkable adhesive-lined sleeve to provide a waterproof seal, or factory approved taping kit such as Scotch 5717, or equal.
- D. Splices shall accommodate a range of cable sizes and be completely independent of cable manufacturer tolerances. Splices shall be capable of being properly installed on out of round cable in accordance with ICEA and AEIC standards. Kits shall accommodate commercially available connectors.

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- E. Splices, which consist of three or more cables, shall be performed with 600 AMP Elastamold T Bodies, Hubbell, Cooper or equal. The splice shall be capable of removing or adding a conductor and restoring the connection in an electrically safe and waterproof condition. Installation of 200 AMP T Bodies is not permitted.

3.04 CLEANUP

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

3.05 PROTECTION

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

END OF SECTION

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SECTION 26 05 19 - LOW-VOLTAGE WIRES (600 VOLT AC)

PART 1 - GENERAL

1.01 SUMMARY

- A. Provisions of Division 01 apply to this section.
- B. Section Includes: Low-voltage wire, splices, terminations and installation.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. List of Materials: Submit a complete list of proposed materials.
- C. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, insulation type, resistivity, conductivity, impedance, and conductance. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.
- D. Prior to start of construction; provide letter from wiring and electrical cables manufacturer certifying that the products are qualified/ listed as low electromagnetic field products.

1.03 SUBSTITUTIONS

- A. Deviations/Substitutions from these requirements shall not be accepted without written approval from OWNER'S Design Standards Section and Maintenance and Operations Technical Unit. When deviating are proposed the following information shall be submitted:
 - 1. Substitution request form stating reasons and benefits to OWNER.
 - 2. OWNER'S approval shall be obtained for any equipment or materials substitutions.
 - 3. Proposed substitutions requests shall provide proof of compliance with OWNER'S requirements and applicable standards.
- B. Submittals must comply with contract general provisions.

1.04 QUALITY ASSURANCE

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- A. Components and materials shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL), and in compliance with applicable industry standards and codes.
- B. Wiring installation shall be performed under the supervision of state certified electricians. Contractor or Installer's electricians shall be certified in accordance with Labor Code sections 3099, and 3099.2 and section 209.0 of the California Code of Regulations.
- C. Contractor shall have adequate experience installing systems of similar size and complexity.
 - 1. Qualifications of Installer: Minimum five years of experience installing products and systems of similar scope and complexity.
 - 2. Installer shall have completed at least five projects of equivalent scope and complexity.
 - 3. Contractor shall have completed and commissioned a minimum of five service agreements that provide similar support services to those needed for this project.
 - 4. System startup and testing shall be performed under direct observation of the Project Inspector and OAR.
- D. The Project Inspector will observe installation of feeder cables. Notify the Project Inspector not less than two working days in advance of the proposed time of feeder installation.

1.05 WARRANTY

- A. Provide a one year labor warranty.
- B. Provide material warranty of no less than 10 years.
- C. Warranty period begins at substantial completion or project acceptance for beneficial occupancy.
- D. CONTRACTOR shall warranty all products and materials. Multiple warranty sources is not acceptable.

PART 2 - PRODUCTS

2.01 WIRES

Budlong

3361-008-000

LOW VOLTAGE WIRES (600 VOLT AC)

27 05 19-2

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- A. Pressure cable connectors shall be pre-insulated 3M Scotchlok, Ideal Wing Nut, O-Z/Gedney or equal.
- B. Wires shall be single conductor type THHN or THWN insulated with polyvinyl chloride and covered with a protective sheath of nylon, rated at 600 volts. Wires may be operated at a maximum continuous conductor temperature in dry locations of 90 degrees C. and 75 degrees C. in wet locations. Wires and cables shall be listed by Underwriter's Laboratories (UL) Standard 83 for thermoplastic insulated wires and listed for installation in accordance with Article 310 of the California Electrical Code (CEC).
- C. Conductors shall be solid copper for 12 AWG and smaller conductors, and stranded copper for 10 AWG and larger conductors.
- D. Conductors shall be insulated with PVC and sheathed with nylon.
- E. Wires shall be identified by surface markings indicating manufacturer's identification, conductor size and metal, voltage rating, UL symbol, type designations and optional rating. Indentations for lettering are not permitted.
- F. Wires shall be tested in accordance with the requirements of UL standard for types THWN and THHN.
- G. Conductors shall be solid Class B or stranded Class C annealed uncoated copper in accordance with UL standards, or another Nationally Recognized Testing Laboratory (NRTL).

2.02 STANDARDS

- A. THWN/THHN wires shall comply with the following standards:
 - 1. UL 83 for thermoplastic insulated wires.
 - 2. UL 1063 for machine tool wires and cables.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Wires shall not be installed until debris and moisture is removed from conduits, boxes, and cabinets. Wires stored at site shall be protected from physical damage until they are installed and walls are completed.
- B. Wire-pulling compounds furnished as lubricants for installation of conductors in raceways shall be compounds approved and listed by UL, NRTL, or equal. Oil, grease, graphite, or similar substances are not permitted. Pulling of 2 AWG or larger

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conductors shall be performed with a cable pull machine. Any runs shorter than 50 feet are exempt. When pulling conductors, do not exceed manufacturer's recommended values

- C. At outlets for light, power, and signal equipment, pigtail splices with 8-inch circuit conductor leads for connection to fixtures, equipment, and devices.
- D. Pressure cable connectors, Yellow, Red, or Blue spring-loaded twist-on type, may be furnished in splicing number 8 AWG or smaller wires for wiring systems. Listed Push-in spring clamp wire connectors, Ideal In-Sure, or equal may be used in luminaires for fixture wiring.
- E. Joints, splices, taps, and connections to switchboard neutral, bonding or grounding conductors, conductors to ground busses, and transformer connections for wires 6 gage and larger shall be performed with high-pressure cable connectors approved for installation with copper conductors. Connectors shall be insulated with heavy wall heat shrink WCSM, or cold-applied roll-on sleeve RVS. Insulation level shall be a minimum of 600V and joints, splices, and taps shall be qualified to ANSI C 119.1, UL, NRTL, or equal listed mechanical pressure connections.
- F. Connections to any bussing and high-press cable connectors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.
- G. Connection of any bonding or grounding conductors shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.
- H. Wire switchboards, panel cabinets, pull boxes, and other cabinets except public address, shall be neatly grouped and tied in bundles with nylon ties at 10-inch intervals. In switchboards, panels and terminal blocks, wires shall be fanned out to terminals. If bundles are longer than 24 inches, a maximum of nine current carrying conductors may be bundled together.
- I. Install conductor lengths with a minimum length within the wiring space. Conductors must be long enough to reach the terminal location in a manner that avoids strain on the connecting lug.
- J. Maintain the conductor required bending radius.
- K. Neutral conductors larger than 6 gage, which are not color identified throughout their entire length, shall be taped, painted white or natural gray, or taped white where they appear in switchboards, cabinet, gutters or pull boxes. Neutral conductors 6 gage and smaller shall be white color identified throughout their entire length.

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- L. Fire alarm and clock wiring shall be continuous from terminal cabinets or from equipment to each device. Splices are not permitted between devices and/or terminal cabinets at junction and pull boxes. Wiring shall be terminated at terminal blocks or devices only.

- M. Wiring systems shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of feeder and branch circuit conductor's insulation resistance. The insulation of the conductors shall be tested prior to connections to any panelboards, switchboards, variable frequency drives, lighting control systems, ballasts, and wiring devices such as but not limited to GFI receptacles, TVSS receptacles, or equipment. Insulation testing of panelboards and switchboards shall be independently performed from the insulation testing of any conductors as specified in other sections of this specification.
 - 1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of feeder conductors. Tests must be conducted with wires disconnected at both ends.
 - a. Provide calibration program records to assure the testing instrument to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).
 - b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.
 - c. Test reports shall include the following:
 - 1) Identification of the testing organization.
 - 2) Equipment identification.
 - 3) Ambient conditions.
 - 4) Identification of the testing technician.
 - 5) Summary of project.
 - 6) Description of equipment being tested.
 - 7) Description of tests.
 - 8) Test results.
 - 9) Analysis, interpretation and recommendations.
 - 2. Utilize the services of an approved independent testing laboratory or a qualified contractor's employee (Technician certified in accordance with ANSI/NETA ETT-2000 Standard for Certification of Electrical Testing Personnel) to perform

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megger time-resistance insulation testing of branch circuit conductors. Tests must be conducted with wires disconnected at both ends.

a. Test equipment and report requirements stipulated under paragraph 3.01.N.1 apply to branch circuit testing.

3. Tests shall be performed in the presence of the Project Inspector.

4. Insulation resistance shall not be less than 100 mega-ohms.

3.02 COLOR CODES

A. General Wiring:

1. For phase and neutral conductors 6 gage or larger, permanent plastic-colored tape may be furnished to mark conductor end instead of coded insulation. Tape shall cover not less than 2 inches of conductor insulation within enclosure.

2. Color code conductor insulation as follows:

SYSTEM VOLTAGE		
Conductor	208Y/120	480Y/277
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Natural Gray

Neutrals shall be colored-distinguished if circuits of two voltage systems are used in the same raceway.

3. Where two voltage systems are combined in an enclosure; CONTRACTOR shall apply a permanent color code label where the circuits originate.

B. Signal Systems: Wires for signal systems shall be color-coded and installed under observation of the Project Inspector. Also, refer to Div. 27 & Div. 28 for specific requirements of the systems. Except where otherwise specified, color-coding shall be as follows:

<u>SYSTEM</u>	<u>COLOR CODE</u>
Clocks	Pink, Gray and Orange
Program Bells (some existing elementary schools)	White (Common)Black

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Initiating Devices (Non-Addressable)	Red (+) and Black (-)
Program Bells (some existing secondary schools)	White (120 volt, common) Black (C.R. program) Blue (Shop program) Brown (Gym program) Yellow (Auditorium fire alarm)
Fire Alarm Horns	Pink (+) and Gray (-)
Fire Alarm Strobes	Orange (+) and Blue (-)
Un-Interruptible 24 Volt Power (Annunciator, Water Flow, and Audible Device)	Yellow (+) and White (-) Note: A single white wire may be common to both
Interruptible 24 Volt Power (4 wire smoke detectors, duct detectors)	Brown (+) and White (-) Note: A single white wire may be common to both
Switch-Leg Sprinkler Bell (Between water flow and audible device)	Violet (+) and White (-)
Door Holding Magnets (Non Power Limited)	Black (+) and White (-)

3.03 FEEDER IDENTIFICATION

- A. Feeder wires and cables shall be identified at each point the conduit run is broken by a cabinet, box, gutter, etc. Where terminal ends are available, identification shall be by means of heat shrink wire markers, which provide terminal strain relief. Markers shall be by Tyco Electronics, Panduit, Brady Perma-Sleeve, or equal. Identification in other areas shall be by means of wrap-around tape markers from Tyco Electronics, Panduit, Brady Perma-Code or equal. Markers shall include feeder designation, size, and description.

3.04 TAPE AND SPLICE KITS

- A. Splices, joints, and connectors joining conductors in dry and wet locations shall be covered with insulation equivalent to that provided on conductors. Free ends of conductors connected to energized sources shall be taped. Voids in irregular connectors shall be filled with insulating compound before taping. Thermoplastic insulating tape approved by UL, NRTL, or equal for installation as sole insulation of splices shall be furnished and shall be installed according to manufacturer's printed specifications.

3.05 PROTECTION

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

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3.06 CLEANUP

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

END OF SECTION

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SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide and install an effective grounding and bonding system.
- B. Related Requirements:
 - 1. Refer to related sections for their system grounding requirements.
 - 2. Division 01 - General Requirements.
 - 3. Division 26 – Electrical.
 - 4. Division 27 – Communications.
 - 5. Division 28 - Electronic Safety and Security.

1.02 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. IEEE 142 Green Book.
 - 2. Underwriter's Laboratories (UL).
 - 3. California Electrical Code.
 - 4. Building Industry Consultant Services International (BICSI).
 - 5. EIA/TIA (Signal and power).
 - 6. Nationally Recognized Testing Laboratory (NRTL).

1.03 SYSTEM DESCRIPTION

- A. Equipment, components, or materials that enclose electrical conductors, or are likely to be energized by electrical currents shall be effectively grounded.
- B. Metal equipment parts such as switchboards, panelboards, metal enclosures, raceways, equipment grounding conductors, and earth grounding electrodes shall be effectively bonded into a continuous grounding path.

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- C. Metallic systems or electrically conductive materials shall be effectively bonded to the building's grounding electrode system.

- D. A separately derived AC system shall be grounded to the equipment grounding conductor and to a separate "made" electrode of building grounding electrode system.

- E. Provide effective electrical equipment bond continuity to all metal raceways and enclosures. Grounding shall be achieved through a code sized green insulated grounding conductor provided within each raceway.
 - 1. Each flexible conduit over six feet in length shall be provided with a green insulated grounding conductor of required size.
 - 2. Provide code sized equipment grounding conductor in all flexible conduits as required by CEC.
 - 3. The length of flexible conduit installations shall not be less than six feet.
 - 4. Effectively ground metal raceways and enclosures at each end.

- F. Cold water, or other utility piping systems, shall not be utilized as grounding electrodes. In addition to bonding to cold water pipe provide at least one of the following made grounding electrodes:
 - 1. A dedicated "made" electrode, fabricated of at least 20 feet of uncoated galvanized 1/2 inch diameter rebar encased by at least two inches of concrete, and placed next to the bottom of a concrete foundation, or footing in direct contact with earth. A welded extended portion shall surface at the location of the common grounding electrode bus bar and be extended by a 3/0 exothermic welded bare copper cable, or be welded directly to the bus. The exothermic weld shall be at least four inches above finished floor in a dry location. The main grounding electrode and associated grounding conductors shall be in an enclosure and in conduit.
 - 3. Concrete enclosed electrode, fabricated of at least 20 feet of No. 2 AWG, minimum size, bare copper conductor, encased by at least two inches of concrete, located within or near bottom of a concrete foundation, or footing, which is in direct contact with earth. Footing rebar shall be connected to copper wire with approved connectors.
 - 4. An external grounding electrode, as specified hereafter or as required by the CEC shall be installed and connected to foundation or footing rebar.

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- G. Non-current carrying metal parts of high-voltage (1000 Volts or more) equipment enclosures, signal and power conduits, switchboard and panelboard enclosures, motor frames, equipment cabinets, and metal frames of buildings shall be permanently and effectively bonded to the grounding system. Provide a CEC sized equipment grounding conductor in every raceway.
- H. Metallic or semi-conducting shields and lead sheaths of cables operating above 1000 Volts shall be permanently and effectively grounded at each splice and termination.
- I. Neutral of service conductors shall be grounded as follows:
 - 1. Neutral shall be solidly grounded at only one point within the Project site for that particular service. Preferable location of grounding point shall be at the service switchboard, or main switch.
 - 2. Equipment and conduit grounding conductors shall be bonded to that grounding point.
 - 3. If other buildings or structures on the Project site are served from a switchboard or panelboard in another building, power supply is classified as a feeder and not as a service.
 - 4. Equipment grounding conductor shall be installed from switchboard to each individual building. At building, grounding conductor shall be bonded with power equipment enclosures, metal frames of building, etc., to "made" electrode for that building.
 - 5. Feeder neutrals shall be bonded at service entrance point only; neutrals of separately derived systems shall be bonded at the source only.
- J. If there is a distribution transformer at a building the secondary neutral conductor shall be grounded to "made" electrode serving the building.
- K. Within every building, the main switchboard or panelboard, shall be bonded to the cold water line. Metallic piping systems such as gas, fire sprinkler, or other systems shall be bonded to the cold water line.

1.04 SUBMITTALS

- A. Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.01 MATERIALS

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- A. Furnished yard boxes shall be precast concrete and shall be approximately 14 inches wide by 19 inches long by 12 inches deep or larger.
 - a. Boxes shall be furnished with bolt-down, checkered, cast iron covers and cast-iron frames cast into the yard boxes.
 - b. Provide yard boxes with hinged Frame Locking Cover.
 - c. Approved products include Brooks No. 36 HFL, Jensen Precast, Oldcastle Precast, Western Precast, Kistner, or equal.
- B. External ground electrodes shall be copper-clad steel ground rods, minimum 3/4-inch diameter by ten feet long.
- C. Clamps and fittings used in ground boxes below grade shall be listed for direct burial.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Grounding electrodes shall be installed in the nearest suitable planting area, where not otherwise indicated on Drawings, and each electrode shall terminate within a concrete yard box installed flush with finish grade. In planting areas, finish elevation of concrete yard boxes shall be two inches above planting surfaces.
- B. If concrete enclosed electrode is provided, grounding wire shall be terminated to a suitable copper plate with grounding lugs and must be enclosed in a raceway or box.
- C. Grounding rods shall be driven to a depth of not less than eight feet. Permanent ground enhancement material, (GEM) as manufactured by Erico Electrical Products, Loresco Powerset, Tessco Ultrafil or equal, shall be installed at each ground rod to improve grounding effectiveness. Install in accordance with manufacture's installation instructions.
- D. Grounding electrodes shall provide a resistance to ground of not more than 25 ohms.
- E. When installing grounding rods, if resistance to ground exceeds 25 ohms, two or more rods connected in parallel, or coupled together shall be provided to meet CEC grounding resistance requirements.
- F. Ground rods shall be separated from one another by not less than ten feet.
- G. Parallel grounding rods shall be bonded together with listed fittings and grounding conductors in galvanized rigid steel conduit, buried not less than 12 inches below finish grade.

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3.02 TESTING

- A. Provide the services of an approved independent testing laboratory to test grounding resistance of “made” electrodes, ground rods, bonding of building steel, water pipes, gas pipes and other utility piping. Tests shall be performed as follows:
1. Visually and mechanically examine ground system connections for completeness and adequacy.
 2. Perform fall of potential tests on each ground rod or ground electrode where suitable locations are available per IEEE Standard No. 81, Section 8.2.1.2. Where suitable locations are not available, measurements will be referenced to a known dead earth or reference ground.
 3. Perform the two-point method test per IEEE No. 81, Section 8.2.1.1 to determine ground resistance between ground rod and building steel, and utility piping - such as water, gas and panelboard grounds. Metal hand railings at building entrances and at handicapped ramps shall also be tested.
 4. Test shall be performed in the presence of the Inspector.
- B. Submit 3 copies of test results to the Architect. Test results shall be submitted on an official form from the independent testing laboratory recording Project location, test engineer, test conditions, test equipment data, ground system layout or diagram, and final test results.

3.03 PROTECTION

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

3.04 CLEANUP

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

END OF SECTION

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SECTION 26 05 33 - RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Raceways and wire ways.
 2. Conduit installation.
 3. Underground requirements.
- B. Related Requirements:
1. Section 26 05 00: Common Work Results for Electrical.
 2. Section 26 05 13: Basic Electrical Materials and Methods.
 3. Division 27: Communications.
 4. Division 28 - Electronic Safety and Security.
- C. Applicable Standards and Codes.
1. EIA/TIA 569 Standards.
 2. National American Standards Institute (ANSI).
 3. National Electrical Manufacturer's Association (NEMA).
 4. Nationally Recognized Testing Laboratory (NRTL).
 5. California Electrical Code (CEC).
 6. Uniform Building Code (UBC).
 7. Underwriters Laboratory (UL).

1.02 SUBMITTALS

- A. Materials List: Provide in accordance with Division 01.

PART 2 - PRODUCTS

2.01 RACEWAYS

- A. Conduit Materials:
1. Metallic conduit, and tubing shall be manufactured under the supervision of an UL, or another NRTL factory inspection and label service program. Each ten-foot length of conduit and tubing shall bear the UL or another NRTL label and manufacturer's name.

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2. Rigid metallic conduit shall be rigid steel, heavy wall, mild steel, zinc-coated, with an inside and outside protective coating manufactured in accordance with ANSI C 80.1. Couplings, elbows, bends, conduits, bushings and other fittings shall be the same materials and finish as the rigid metallic conduit. Fittings, connectors, and couplings shall be threaded type, manufactured in accordance with ANSI C 80.1 and UL 6.
 3. Electrical metallic tubing shall be steel tubing, zinc-coated with a protective enamel coating inside, manufactured in accordance with NEMA C 80.3. Fittings, couplings, and connectors shall be gland compression type, set screw couplings and connectors not permitted. All parts shall be manufactured in accordance with NEMA C80.3 and UL 6A Electrical metallic tubing is designated hereinafter as EMT. Steel and rain tight fittings shall be approved and listed for the intended application.
 4. Flexible steel conduit shall be of flexible interlocking strip construction with continuous zinc coating on strips, manufactured in accordance with UL 1.
 - a. Connectors and couplings shall be required fittings of the type, which threads into convolutions of flexible conduit.
 5. Liquid-tight flexible metal conduit shall be galvanized heavy wall, flexible locked steel strip construction, UV rated, with smooth moisture and oil-proof, abrasion-resistant, extruded plastic jacket. Connectors shall be as required for installation with liquid-tight flexible conduit and shall be installed to provide a liquid-tight connection.
 6. Non-metallic conduit shall be rigid PVC electrical conduit extruded to schedule 40 dimensions of Type II. Grade 1 high impact, polyvinyl chloride, sweeps, couplings, reducers and terminating fittings shall be listed under the UL, or another NRTL, and shall bear the manufacturer's listed marking.
 7. Multi-cell raceway shall be four inch PVC, Type 40, UL or another NRTL listed for underground use with optical fiber and signal system cables. Raceway shall be furnished with 3-1/2 inch factory installed inner ducts with required internal spacers, and required couplers, sweeps, and end bells. Multicell raceway shall be Carlon Multigard, or District approved equal.
 8. Metal Clad (MC) cable system is not allowed.
- B. Sleeves for Conduits: Sleeves shall be adjustable type by Carlon, U.S. Plastic, PEP Plastic or equal.
- C. Where conduit enters a building through a concrete foundation below grade, or ground water level, or where it is necessary to seal around a conduit where it passes through a concrete floor or wall, provide O-Z/Gedney Type FSK Thru Wall and Floor Seal, equivalent Cooper Crouse Hinds Thru-Wall, Legrand Thru-Wall, or equal.

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- D. Expansion Joints-Seismic Separations between building(s) and other locations as indicated on drawings:
1. Provide Thomas & Betts XJG-TB, O-Z/Gedney. type AX with bonding strap and clamps, Cooper XJGD or equal. At exterior locations, provide Thomas & Betts XJG-TB, O-Z/Gedney type EX, Cooper XJGD, or equal. Provide O-Z/Gedney type AXDX, or equal combination deflection/expansion fittings at all seismic separations. Provide manufacture's internal and external bonding jumpers at all locations. Liquid-tight metal conduit or flexible metal conduit shall not be approved at expansion joints, separations between buildings or seismic separations.
 2. Provide expansion fittings at intervals not exceeding 100 feet in conduits exposed to direct sunlight. Fittings may be installed in the conduit run or where conduit attaches to junction or pull boxes. OZ/Gedney type AX, TX or EXE series, or equivalent by Thomas and Betts, Crouse-Hinds or approved equal.
- E. Conduit Seal Fittings:
1. Provide conduit seal fittings where indicated on the Drawings. Conduit seals shall be of rigid galvanized steel. Seals in horizontal conduit installations shall be Thomas & Betts EYS, Appleton Type ESU, Crouse Hinds Type EYS, or equal. Seals in vertical conduit installations shall be Thomas & Betts EYD, Appleton Type SF, Crouse Hinds Type EYD, or equal, with continuous drain. When installing conduit seals make provision for percent fill space reduction in accordance with CEC.
 2. Install sealing compound after wire has been installed. Ensure drain is not blocked in vertical seals when installing compound. Where conduit seals are installed in hazardous area applications, there shall be no conduit coupling, fitting, etc., between seal and boundary of hazardous area.
- F. Penetration in Fire-Rated Structures: Provide 3M, or equal, sealant and fire barriers for installing fire-rated seals around penetrations through floors, walls, and elevator hoistways. Fire stop system must be UL, or another NRTL listed, and classified for through-penetration applications of metallic conduits and busways.
- G. Pull Wires: Install 1/8 inch polypropylene cords in empty or spare conduits.

PART 3 - EXECUTION

3.01 CONDUIT INSTALLATION

- A. General Requirements:

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1. Provide complete and continuous systems of rigid metallic conduit, outlet boxes, junction boxes, fittings and cabinets for systems of electrical wiring including lighting, power, and signal systems, except as otherwise specified.
2. EMT may be installed in interior concealed applications and in areas approved by owner. EMT shall not be installed in concrete, directly buried underground, outdoors, in boiler rooms, elevator pits, or where subject to damage.
3. Within buildings, flexible steel conduit may be installed instead of rigid steel conduit where permitted by code. Flexible steel conduit shall be installed:
 - a. For continuous lengths not exceeding more than 50 feet between pull points (pull boxes, outlet boxes, etcetera).
 - b. With no maximum total raceway length located within a building interior when the flex is located in concealed locations.
4. Flexible Steel conduit shall not exceed 1-1/2 inches in size.
5. Liquid-tight flexible steel conduit shall only be installed, except where otherwise specified, for final connection of motor terminal boxes, shop equipment, cafeteria equipment, HVAC equipment and other equipment, or for frequent interchange, and shall be of sufficient length, not exceeding 36 inches, to permit full travel or adjustment of motor on its base. Liquid-tight flexible conduit shall not be used for equipment not requiring adjustment or frequent interchange.
6. Connectors for flexible metal conduit shall be made of steel, and of the types which threads into convolutions of conduit. Connectors for watertight flexible metal conduit shall be as required for installation and shall be installed to provide a watertight connection.
7. Exposed conduit shall be installed vertically and horizontally following the general configuration of the equipment, using cast threaded hub conduit fittings where required and shall be clamped to equipment with suitable iron brackets and one hole pipe strap.
8. If connection is from a flush wall-mounted junction box, install an approved extension box.
9. Underground feeder distribution conduits for systems may be non-metallic conduit instead of rigid conduit except where otherwise specified or indicated.
10. Conduit shall be concealed unless otherwise indicated. Conduits exposed to view, except those in attic spaces and under buildings, shall be installed parallel or at right angles to structural members, walls, or lines of building. Conduits shall be installed to clear access openings.
11. Bends or offsets will not be permitted unless absolutely necessary. Radius of each conduit bend or offset shall be as required by ordinance. Bends and offsets shall be performed with standard industry tools and equipment or may be factory fabricated bends or elbows complying with requirements for radius of bend specified. Heating of metallic conduit to facilitate bending is not

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permitted. Public telephone conduit bends and offsets shall be provided with a radius which is not less than ten times trade size of conduit unless otherwise permitted. Refer to underground installation, specified in this section, for radius of bends and offsets required for underground installations.

12. Running threads are not permitted. Provide conduit unions where union joints are necessary. Conduit shall be maintained at least six inches from covering of hot water and steam pipes and 18 inches from flues and breechings. Open ends of conduits shall be sealed with permitted conduit seals during construction of buildings and during installation of underground systems.
13. Expansion Joints/Seismic Separations/Separations between buildings/Locations Indicated: Provide Thomas & Betts XJG-TB, O-Z Electrical Mfg. Co. Inc. Type AX with bonding strap and clamps. Crouse Hinds XJGD, or equal. At exterior locations, provide Thomas & Betts XJG-TB, O-Z Electrical Mfg. Co. Inc. Type EX, Crouse Hinds XJGD, or equal. Provide Crouse Hinds, Thomas & Betts, or O-Z Electrical Mfg. Co. Type AXDX, or equal Combination Deflection/Expansion Fittings at all seismic separations. Provide manufactures internal and external Bonding Jumpers at all locations. Liquid-tight flexible conduit shall not be approved at expansion joints or seismic separations.
14. Where conduits are terminated in groups at panelboards, switchboards, and signal cabinets, etc., provide templates or spacers to fasten conduits in proper position and to preserve alignment. Conduits terminating at signal cabinets shall only enter cabinets in the following locations:
 - a. Conduits entering top, side, and bottom of cabinets shall be aligned in a single row, centered two inches from rear of cabinet.
 - b. Conduits entering back of cabinet shall be aligned in a single row centered two inches from top of cabinet.
 - c. Conduits shall not be spaced closer than three inches on centers.
15. Conduits above metal lath ceilings shall be rigidly suspended with pipe hangers or pipe racks or shall be secured to superstructure with factory fabricated pipe straps. Conduits in metal lath or steel stud partitions shall be tied to furring channels or studs. In ceiling spaces and in partitions, tie wires shall be spaced not more than 5 feet apart, shall fasten conduit tight against channels and studs at point of tie and shall not support any of conduit weight. Tie wire shall be 16 gage galvanized double annealed steel.
16. Where auxiliary supports, saddles, brackets, etc., are required to meet special conditions, they shall be fastened rigid and secure before conduit is attached.
17. Conduit in ceiling spaces, stud walls, and under floors, shall be supported with factory fabricated pipe straps or shall be suspended with pipe hangers or pipe racks. Pipe straps shall be attached to and shall fasten conduit tight at point of support against ceiling and floor joists, rafters, and wall studs, or 2" X 4" headers fitted between joists or wall studs.

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18. Conduits installed on exposed steel trusses and rafters shall be fastened with factory fabricated conduit straps or clamps, which shall fasten conduit tight against supporting member at point of support.
19. Conduits installed under buildings shall be strapped with factory fabricated conduit straps to underside of concrete floor or joists, or wood floor joists, or shall be suspended with pipe hangers or pipe racks. Conduits under building are not permitted to be placed directly on grade; they shall be suspended from building or shall be buried below surface or ground. 1-1/4 inch and larger conduits under buildings shall be installed with conduit hangers or racks.
20. Pipe hangers for individual conduits shall be factory fabricated. Steel rods shall be 3/8 inch for two-inch conduit hangers and smaller and shall be 1/2 inch for 2 1/2-inch conduit hangers and larger.
21. Pipe racks for groups of parallel conduits and for supporting total weights not exceeding 500 pounds shall be trapeze type and shall consist of a cross channel, Steel City Kindorf B-900, Unistrut P-1000, equivalent Cooper B-Line or equal, suspended with a 3/8 inch minimum diameter steel rod at each end. Rods shall be fastened with nuts, top and bottom to cross-channel and with square washers on top of channel. Conduits shall be clamped to top for cross-channel with conduit clamps, Steel City Kindorf C-105 or Unistrut P-1111 through P-1124, equivalent Cooper B-Line, or equal. Conduits shall not be stacked one on top of another, but a maximum of two tiers may be on same rack providing an additional cross-channel is installed. Where a pipe rack is to be longer than 24 inches, or if the supported weight exceeds 500 pounds, submit Shop Drawings of installation to the Architect for review.
22. Conduits suspended on rods more than two feet long shall be rigidly braced to prevent horizontal motion or swaying. Installation shall meet zone 4 seismic requirements.
23. Factory fabricated pipe straps shall be one or two-hole formed galvanized clamps, heavy-duty type, except where otherwise specified.
24. Hangers, straps, rods, or pipe supports under concrete shall be attached to inserts set at time concrete is placed, or with approved concrete anchors. Under wood, install bolts, lag bolts, or lag screws; under steel joists or trusses, install beam clamps. Contractor shall submit size of anchors, bolts, screws, and installation method to Architect for approval prior to start of any work.
25. Conduits shall be supported at intervals required by code, but not to exceed ten feet. One inch and smaller exposed conduits shall be fastened with one-hole malleable iron straps. Perforated straps and plumber's tape is not permitted for the support of conduits.
26. Conduits stubbed up through a roof or an arcade shall be flashed with a waterproof flashing. Refer to Division 07 for additional requirements.

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27. Bushings and locknuts for rigid steel conduit shall be steel threaded insulating type. Setscrew bushings are not permitted.
28. Flex conduits shall be cut square and not at an angle.
29. Routing of conduits may be changed providing length of any conduit run is not increased more than ten percent of the length indicated on Drawings.

B. Underground Requirements:

1. Conduits and multicell raceways installed underground shall be entirely encased in three inch thick concrete on all sides, except where otherwise specified. Provide required spacers to prevent any deflection when concrete is placed and to preserve position and alignment. Conduits and raceways shall be tied to spacers. Anchors shall be installed to prevent floating of conduits and raceways during placing of concrete. Provide red colored concrete to encase conduits of systems operating above 600 volts.
2. Underground conduits and raceways shall be buried to a depth of not less than 24 inches below finished grade to top of the concrete envelope, unless otherwise specified.
3. Assemble sections of conduit with required fittings. Cut ends of conduit shall be reamed to remove rough edges. Joints in conduits shall be provided liquid-tight. Bends at risers shall be completely below surface where possible.
4. Conduits and raceways in a common trench shall be separated by at least three inches of concrete. Electrical power and/or lighting conduit runs installed in a common trench with conduits containing signal system wiring such as public address, telephone, intrusion detection, fire alarm, television, computer networking, and clock systems shall maintain a separation of a minimum of six inches from these types of signal system conduits and raceways. Electrical power, lighting and signal conduits and raceways installed in a common trench with other utility lines such as gas, water, sewer and storm lines shall maintain 12 inches separation from these types of utility lines.
5. The Inspector will observe underground installations before and during concrete placement. A mandrel shall be drawn through each run of conduit in presence of the Inspector before and after placing concrete. Mandrel shall be six inches in length minimum, and have a diameter that is within 1/4 inches of diameter of conduit to be tested.
6. Non-metallic conduit installations shall comply with following additional requirements. Joints in PVC conduit shall be sealed by means of required solvent-weld cement supplied by conduit manufacturer. Non-metallic conduit bends and deflections shall comply with requirements of applicable electrical code, except that minimum radius of any bend or offset for conduits sized from 1/2 inch to 1 1/2-inch inclusive shall not be less than 24 inches. Bends at risers and risers shall be PVC-coated rigid steel conduit. Radius of curve of bends or

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offsets in non-metallic conduit for public telephone system shall be not less than ten times trade size of conduit, unless otherwise specifically permitted.

7. Furnish and install a six-inch wide, polyethylene, red underground barrier type 12 inches above full length of concrete reading, "CAUTION ELECTRIC LINE BURIED BELOW".
 8. Underground conduit systems provided for utility companies shall be furnished to meet the requirements of the utility companies requiring service.
 9. Protect inside of conduit and raceway from dirt and rubbish during construction by capping openings.
 10. Add bell-end bushings for conduit stub-up including underground entries to pull boxes, and manholes. Under floor standing switchboards and motor control centers provide a four-inch galvanized nipple with ground bushing.
 11. Underground conduit for systems operating above 600 volts shall be a minimum size of four inches.
 12. At portable classroom all stub ups shall be installed with a coupling flush to finish grade.
 13. Underground conduits and raceways shall be swabbed prior to wire pull.
- C. Rooftop conduit shall be supported from channels, stands, clamps, trapezes, rollers, or structures mounted on 100% rubber, UV resistant rooftop supports with reflective strips, Dura-Blok, or equal. Roller type supports shall be provided below and above conduit to prevent its dislodgement. Bottom of conduits shall clear the roof surface by 10 inches.
1. At PVC roofing provide walk tread, polyester reinforced, UV resistant, with surface embossment at rooftop supports. Heat welding of walk pads shall only be done by manufacturer certified installers.
 - a. Sika-Sarnafil and Carlisle: Walk tread shall be no more than one inch larger than the plan area of the pipe support blocks and adhered to the roof membrane with Sika 1A or Carlisle Universal Single-Ply sealant, as applicable.
 - b. Johns Manville: Walk tread shall be installed under the pipe support blocks and adhered to the blocks, if possible, and left loose laid on top of the PVC roof system. Walk-pad shall have a minimum of 4 inches of material past perimeter on all 4 sides of block.
 2. Built-up roofing: Provide APP granulated modified torch-down at each pipe support block. Torch-down shall extend 2 to 4 inches beyond the edges of the block and adhered by torch application over existing cap sheet membrane. This work shall be performed by a certified roofer.

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- D. General Installation Requirements for Computer Network System Conduits:
1. Location of outlet boxes and equipment on Drawings is approximate, unless dimensions are indicated. Drawings shall not be scaled to determine position and routing of wireways, drops, and outlet boxes. Location of outlet boxes and equipment shall conform to architectural features of the building and other Work already in place and must be ascertained in the field before start of Work.
 2. The maximum pulling tensions of the specified cables shall not be exceeded and proper radius of cable bends shall be maintained.
 3. For computer network wiring, conduit types shall be limited to rigid metal conduit, electrical metallic tubing, schedule 40 PVC, multi-cell raceways, and flexible metallic conduit for lengths less than six feet.
 4. Interior section of conduit run shall be not longer than 100 feet and shall not contain more than two bends of 90 degrees between pull points or pull boxes.
 5. The inside radius of a conduit bend shall be at least six times the internal diameter of the conduit. When the conduit size is greater than two inches, the inside radius shall be at least ten times the internal diameter of the conduit. For fiber-optic cable, the inside radius of a conduit bend shall be at least ten times the internal diameter of the conduit.
 6. Conduit shall be sized in accordance with Table 4.4-1 of EIA/ TIA 569 standard.
 7. Splicing or terminating cables in pull boxes is not permitted.
 8. For indoor application, a pull box shall be provided in conduit run where:
 - a. The length is over 100 feet.
 - b. There are more than two bends of 90 degrees.
 - c. There is a reverse bend in the run.
 9. Boxes shall be provided in a straight section of conduit and shall not be installed in lieu of a bend. The corresponding conduit ends are to be aligned with each other. Conduit fittings shall not be installed in place of pull boxes.
 10. Where a pull box is provided with raceways, pull box shall comply with the following:
 - a. For straight pull-through, provide a length of at least eight times the trade-size diameter of the largest raceway.
 - b. For angle and U-pulls:
 - 1) Provide a distance between each raceway entry inside the box and the opposite wall of the box of at least six times the trade-size diameter of the largest raceway, this distance being increased by the sum of the trade-size diameters of the other raceways on the same wall of the box.

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- 2) Provide a distance between the nearest edges of each raceway entry enclosing the same conductor of at least:
 - a) Six times the trade-size diameter of the raceway; or
 - b) Six times the trade-size diameter of the larger raceway if they are of different size.
 - c) For a raceway entering the wall of a pull box opposite to a removable cover, provide a distance from the wall to the cover of not less than the trade-size diameter of the largest raceway plus six times the diameter of the largest conductor.
 11. Drawings generally indicate Work to be installed, but do not indicate all bends, transitions of special fittings required to clear beams, girders or other Work already in place. Investigate conditions where conduits and wireways are to be installed, and furnish and install required fittings.
- E. Slabs on Grade:
1. Unless specifically reviewed by the Architect and DSA, conduits 1 ¼-inches and larger are not permitted to be installed in structural concrete slabs. Where conduits are permitted, and are installed in concrete slabs on grade, slabs shall be thickened at bottom where conduits occur to provide three inches of concrete between conduit and earth. Required excavation shall be part of the Work of this section.
 2. If concrete slab is five inches or more in thickness with a moisture barrier plastic sheet between earth and slab, one inch and smaller conduits shall be installed in the slab with a minimum of one inch concrete between earth and conduit.
- F. Concrete Walls, Beams, and Floors: Provide sleeves where conduits pierce concrete walls, beams, and floors, except floor slabs on grade. Sleeves shall provide 1/2 inch clearance around conduits. Sleeves shall not extend beyond exposed surfaces of concrete and shall be securely fastened to forms. Where conduits pass through walls below grade, seal with required sealant and backer materials between conduit and sleeve to provide a watertight joint. Sealant shall be as indicated in Section 07 9200: Joint Sealants.

3.02 STUBS

- A. Panelboard: Install two one inch conduits from each flush mounted panelboard to access under floor space and to access above ceiling space where these conditions occur. Cap conduits with standard galvanized pipe caps.
- B. Floor: At points where floor stubs are indicated in open floor areas, for connections to machines and equipment, conduits shall be terminated with couplings, tops flush with finished floor. Stubs shall extend above couplings the indicated distance. Where capped stubs are designated, couplings shall be closed with cast iron plugs with screw drive slots.

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C. Underground:

1. Underground conduit stubs shall be terminated at locations indicated, and shall extend five feet beyond building foundations, steps, arcades, concrete walks and paving. Rigid metallic conduit stubs and non-metallic conduit stubs shall be capped by installing a coupling flush in end wall of concrete encasement and plugging with a permitted plug. Project record drawings shall indicate location of ends of underground conduit stubs fully dimensioned and triangulated with reference to buildings or permanent landmarks. These dimensions, including depth below finished grade, shall be marked on project record drawings in presence of the Inspector before backfilling trench. Where extending existing concrete encased stubs, clean, chip and wire brush end of existing concrete and brush on a heavy coat of neat cement paste or epoxy bonding agent.
2. Over ends of individual underground conduit stubs or groups of conduit stubs, install four-inch by 18-inch deep PVC filled with concrete, flush with finished grade in asphaltic concrete or lawns, and two inches above finished grade in planting areas. Cast a three-inch by three-inch brass plate engraved "ELECT" flush in top of concrete. Secure plate to concrete with brass dowels or as indicated on drawings.

3.03 PROTECTION

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

3.04 CLEANUP

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

END OF SECTION

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SECTION 26 08 00 - ELECTRICAL SYSTEMS COMMISSIONING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Section Includes:

1. General requirements for Commissioning (Cx) of lighting systems components, lighting controls and HVAC systems line voltage interconnection components, including installation, start-up, testing and documentation according to construction documents and Commissioning Plan (CxP).
2. Standard procedures for the execution of commissioning work shall be in conformance with Division 1, Section 01 91 13 General Commissioning Requirements. Coordinate work with the Commissioning Services Provider (CxSP).

1.02 RELATED REQUIREMENTS

- A. Division 01 - General Requirements.
- B. Section 01 91 13: General Commissioning Requirements.
- C. Section 01 79 00: Maintenance and Operations Staff Demonstration and Training.
- D. Section 23 80 00: Mechanical Equipment.
- E. Section 23 08 00: Mechanical Systems Commissioning.
- F. Section 23 09 23: Mechanical Environmental Control and Energy Management Systems.
- G. Section 23 08 13: Mechanical Environmental Controls and Energy Management System Commissioning.
- H. Section 26 05 00: Common Work Results for Electrical.
- I. Section 26 05 13: Basic Electrical Materials and Methods.
- J. Section 26 05 26: Grounding and Bonding.
- K. Section 26 05 19: Low Voltage Wires (600 Volt AC).
- L. Section 26 05 86: Motors and Drives.
- M. Section 26 24 19: Motor Control Center and Motor Control Devices.
- N. Section 26 50 10: Solid State Lighting.

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O. Section 26 09 23: Lighting Control Systems.

1.03 REFERENCES

A. Applicable codes, standards, and references: inspections and tests shall be in accordance with the following applicable codes and standards:

1. National Electrical Testing Association – NETA.
2. National Electrical manufacturer's Association – NEMA.
3. American Society for Testing and Materials – ASTM.
4. Institute of Electrical and Electronic Engineers – IEEE.
5. American National Standards Institute – ANSI.
6. National Electrical Safety Code – NESC.
7. California Building Code – CBC.
8. California Electrical Code – CEC.
9. California Green Building Standards Code (CalGreen).
10. Conglomerate for High Performance Schools (CHPS).
11. Insulated Power Cables Engineers Association – IPCEA.
12. Occupational Safety and Health Administration – OSHA.
13. National Institute of Standards and Technology – NIST.
14. National Fire Protection Association – NFPA.
15. California Electrical Code.
16. ANSI/NFPA 70B – Electrical Equipment Maintenance.
17. NFPA 70E – Electrical Safety Requirements for Employee Work Places.
18. ANSI/NFPA 101– Life Safety Code.

1.04 SUBMITTALS

A. Submittals shall include the following:

1. Submit required Cx submittals in accordance with Division 1 Specification Sections.
2. Copy of the Architect's reviewed and accepted submittals to the CxSP via the OAR.
3. List of team members who will represent the CONTRACTOR in the Pre-functional Equipment Checks and Functional Performance Testing, at least two weeks prior to the start of Pre-functional Equipment Checks.

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4. Detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, checklist documentation and field checklist forms to be used by factory or field technicians, and a copy of full details of OWNER-contracted tests, full factory testing reports, if any, and Warranty information, including responsibilities of OWNER to keep Warranty in force, clearly defined.
5. Detailed manufacturer's recommended procedures and schedules for Pre-functional Equipment Checks, supplemented by CONTRACTOR's specific procedures, and Pre-functional Tests, at least four weeks prior to the start of Pre-functional Performance Tests.
6. After facility's commission is complete, submit completed Pre-functional Equipment Checklists and Functional Performance Test checklists organized by system and by subsystem. Bind information in a single package. The results of failed tests shall be included along with a description of the corrective actions taken.

1.05 MEETINGS, SEQUENCING AND SCHEDULING

- A. Meetings: Attend (Cx) meetings as required under Section 01 91 13 and the Cx Plan.
- B. Sequencing and Scheduling: The work described in this Section shall begin only after work required in related Division 26 Sections has been successfully completed, and tests, inspection reports and Operation and Maintenance manuals required in Division 26 Sections have been submitted and approved. The start-up and Pre-functional Equipment Checklists shall be completed and submitted to the OWNER's Authorized Representative (OAR) prior to the functional performance tests. Refer to the project's Cx Plan for more details.
 1. Coordinate electrical work with the work of other trades prior to scheduling of any Cx procedures.
 2. Coordinate the completion of electrical testing, inspection, and calibration prior to start of Cx activities.
 3. Cx activities shall be scheduled in accordance with project's Cx plan.

1.06 QUALITY CONTROL

- A. Comply with OWNER's Quality Control Specifications, Sections 01 45 16 – 01 45 19, as applicable.
- B. Incorporate manufacturer's recommended Cx procedures for the systems and equipment to be commissioned under this Section.

PART 2 - PRODUCTS

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2.01 TEST EQUIPMENT

- A. Equipment to be utilized in the commissioning process shall meet the following requirements:
1. Provide test equipment as necessary for the equipment and systems to be commissioned.
 2. Provide testing equipment and accessories that are free of defects and certified for use.
 3. Provide testing equipment with current calibration labels per NIST Standards.
 4. Testing equipment shall be UL Listed.

PART 3 – EXECUTION

3.01 COMMISSIONING PROCESS REQUIREMENTS

- A. Work to be performed prior to commissioning:
1. Complete all phases of the work so the system(s) can be started, tested, adjusted, balanced, and otherwise commissioned.
 2. Start-up services required to bring each system into full operational state and ready for functional performance testing:
 - a. Completion of authorized manufacturer representative's start-up procedures and recommendations.
 1. Provide Manufacture's start-up completed forms.
 - b. Completion of pre-functional checklists.
 - c. Copy of required manufacturer and field testing.
 - d. Motor rotation check.
 - e. Control sequences of operation.
 - f. Full and partial load performance.
 3. If modifications or corrections to the installed systems are required to bring the system(s) to acceptance levels due to CONTRACTOR's incorrect installation or defective materials, such modifications or corrections shall be made at no additional cost to the OWNER.
 4. Functional tests shall not start until each system is complete and the above items have been documented and submitted to the Engineer of Record, Cx Services Provider and OWNER for review.
- B. Pre-commissioning Responsibilities: Inspection, calibration and testing of the equipment and devices necessary to commission the following systems:

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1. Electrical Lighting Systems.
 2. Lighting Controls.
 3. HVAC line voltage electrical components.
 4. Line voltage interface of Environmental Controls and Energy Management System with other systems.
 5. Photovoltaic Systems.
- C. Commissioning Process Requirements: Refer to Section 01 91 13 General Commissioning Requirements, related sections and Cx Plan for information on meetings, start-up plans, Pre-Functional and Functional Performance Testing (FPT), operations and maintenance data, and other Commissioning activities.

3.02 PREPARATION

- A. Provide certified electricians and/or qualified personnel as required with adequate tools and equipment necessary to perform Cx activities.
- B. Provide all equipment required for the commissioning of equipment and systems indicated in article 3.01.B.
- C. Provide certified testing agency personnel or report(s) as required in the Cx Plan.

3.03 TESTING

- A. Testing documentation shall include the following minimum information:
 1. Test number.
 2. Equipment used for the test, with manufacturer and model number and date of last calibration.
 3. Date and time of the test.
 4. Indication of whether the record is the first commissioning test, or a retest following correction of a previously identified issue.
 5. Identification of the system, subsystem, assembly, or equipment.
 6. Conditions under which the test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of the test.
 7. Systems and assemblies test results, performance and compliance with contract requirements.
 8. Issue number and description of corrected issue that prompted retesting.
 9. Name and signature(s) of witnesses and the person(s) who performed the test(s).

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- B. Test lighting and controls systems to verify performance, operation, functionality, light levels, energy usage, and compliance with construction documents.
1. Start up, test and document results under the observation of the CxSP.
 2. Execute the Functional Performance Test (FPT) under the observation of the CxSP.
 3. Provide completed and signed FPTs to CxSP for inclusion in the commissioning report.
 4. Functions and Testing Conditions:
 - a. Occupancy sensors and timer controls for lighting:
 - 1) Verify that specified functions and features are set up, debugged and fully operable at time of test.
 - 2) Verify that occupant override feature functions as intended in the contract documents.
 - 3) Verify that sensors response times/durations are set properly.
 - 4) Test the sequence of operation for features and modes and confirm that adjustable times match the design specifications and contract documents.
 - 5) Verify that sensors are located per manufacturer's recommendations.
 - b. Electric lighting dimming, photocells and controls:
 - 1) Test the dimming controls during daytime when conditions are such that controls should be dimming electric lighting.
 - 2) Verify that amperage changes in light fixtures are proportional to external light changes. Verify that dimmed light levels uniformity at the specified work plane remain within specified limits.
 - 3) Verify that delays and ramp times are set and functioning so that the speed of change of light fixture output is slow enough to not bother occupants, and in compliance with the specifications.
 - 4) Verify that dimming does not cause lower than specified light levels in adjacent "non-dimmed" spaces.
 - 5) Verify that the controls and sensors cannot be easily overridden or disabled by occupants.
 - 6) Verify that dimming systems in places of assembly are interfaced with the Central Fire Alarm system.

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- 7) Verify that dimmed lighting in these areas shall come back to full bright during a fire alarm or emergency condition.
 - c. Illumination Levels, Night Conditions:
 - 1) Verify that lighting throughout the building is operating automatically.
 - 2) Test with doors closed (to simulate actual occupancy) and after finishes are complete.
 - d. Illumination Levels, Day Conditions:
 - 1) Verify that lighting levels comply with average maintained foot-candle levels shown on plans.
 - 2) Verify that lighting throughout the building is operating automatically.
 - 2) Test with doors closed (to simulate actual occupancy), after finishes are complete, and room is furnished.
 - 3) Test at different times during the day, or under OWNER-approved simulated conditions, to ensure proper system response and to determine that lighting levels are within specified requirements.
 - 4) In classrooms and educational spaces test the system for the different pre-determined settings. Quiet time, AV mode, all on/off, up/down dimming, and standard operations.
 - e. Lighting Power Density: Verify building lighting power density. Perform the test with interior lighting turned on and any manual or automatic controls temporarily overridden. Provide statement of compliance with 100% design energy report. Measurements shall be taken at least one minute after lights are turned on.
 - f. Emergency Lighting System: Verify that the system operates automatically under any condition, without human intervention, and that it resets back to normal operations after the power failure or emergency condition is over or cleared.
5. Acceptance Criteria:
- a. Lighting Controls: For the conditions, sequences and modes tested; dimming, occupancy, photocell, and timing controls, integral components and related equipment shall respond to changing conditions and parameters defined in the Contract Documents.

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- b. Illumination Levels: Average light levels in the tested space at the work plane elevation shall be in the range of plus or minus 10% of the specified light level range for the space.
 - c. Lighting Power Density: Average instantaneous lighting power density shall be within plus or minus ten percent of that indicated in the Construction Documents.
 - d. Power factors on lighting circuits shall be greater or equal to 0.95, or as required by lighting fixture specifications.
 - e. Electrical system total harmonic distortion shall be smaller than 20%.
 - f. Electrical equipment AIC ratings shall be as indicated in construction drawings.
 - g. Feeders % voltage drop. Flag feeders with voltage drop greater than 3%.
6. Sampling Strategy for Identical Units:
- a. Lighting Controls: Test all automatic interior lighting controls.
 - b. Illumination Levels: Test all spaces, zones and rooms to verify as proper light levels.
- C. HVAC Electrical Component Testing
- 1. Document HVAC Division 23 electrical components using the startup procedure submitted by CONTRACTOR and accepted by the CxSP.
 - 2. Complete and submit Start-up, Pre-functional, and Functional Checklists.
 - 3. Verify the following information prior to HVAC system equipment startup.
 - a. Voltage.
 - b. Phase.
 - c. Motor Size.
 - d. Lock Rotor Amperage.
 - e. Full Load Amperage.
 - g. Minimum and Maximum Circuit Ampacity.
 - h. Feeder protection or branch circuit protection, breaker or fuse size as applicable.
 - 4. Coordinate and check corresponding unit electrical protection.

3.04 ADJUSTING

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- A. Incorrect installations, including improper adjustments may result in additional work being required for Cx acceptance.
 - 1. Perform work required to correct installations not meeting contract requirements at no additional cost to the OWNER.
- B. Corrective work shall be completed in a timely manner to permit completion of the Cx process.
 - 1. Refer to the Cx Plan for retesting requirements necessary to achieve required system performance.
 - 2. If the systems' Cx deadline, as defined in the Cx Plan, goes beyond the scheduled completion of commissioning without resolution of the problem, the OWNER reserves the right to obtain supplementary services or equipment to resolve the problem.
 - a. The cost of additional and/or supplementary services inquired by OWNER as a result of CONTRACTOR's lack of performance, or inability to resolve identified issues will be solely the responsibility of the CONTRACTOR.

3.05 TRAINING

- A. Provide training and documentation as required in construction documents.

END OF SECTION

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SECTION 26 09 23 - LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Low-voltage lighting control system.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 26 05 00 – Common Work Results for Electrical.
3. Section 26 05 13 – Basic Electrical Materials and Methods.
4. Section 26 05 19 – Low-Voltage Wires (600 Volt AC).
5. Section 26 05 33 – Raceways, Boxes, Fittings, and Supports.
6. Section 26 08 00 – Electrical Systems Commissioning.
7. Section 26 24 16 – Panelboards and Signal Terminal Cabinets.
8. Section 26 50 00 – Lighting.

1.02 SUBMITTALS

A. Provide in accordance with Division 01.

B. Submit a complete one-line diagram of the proposed system configuration for Architect/Engineer's review. The riser diagram shall identify but not be limited to wiring, equipment, components, interconnection with other systems, and location and type of raceways.

C. Manufacturer's Data: Submit catalog cuts and description of each system component.

D. Provide wiring diagrams and installation details for lighting control equipment.

E. Provide a complete sequence of operation and system interface requirements with fire alarm, and other applicable systems as depicted in construction documents.

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- F. Shop Drawings: Submit a complete set of detailed Shop Drawings for the entire lighting control system; the shop drawings shall include but not be limited to relay panels with designations and dimensions, day light sensor locations based on manufacturer's recommendations, and system components with manufacturer's part numbers.
- G. Installation Instructions: Submit manufacturer's written installation instructions, wiring diagrams. Instructions shall include recommendations for handling of equipment and parts, and protection and storage requirements.
- H. Software flow diagram of and complete sequence of operation.
- I. Software licenses and electronic keys, and list of assigned passwords.
- J. Supplemental local or factory training schedule for post warranty support.
- K. A complete list of recommended spare parts with pricing for the OWNER's use in keeping the environmental control system downtime to a minimum.

1.03 QUALITY ASSURANCE

- A. Components shall be listed and labeled by Underwriter's Laboratories (UL), or another Nationally Recognized Testing Laboratory (NRTL).
- B. Lighting control system and peripheral devices with IP addresses shall be UL listed in compliance with UL-2900 – Cyber Security Network Connected Systems.
- C. Lighting Control Systems shall comply with the state of California Building and Electrical Codes, and Title 24 energy requirements in effect at time of submittal for building permit.
- D. Conduct a coordination meeting with the lighting control contractor, electrical contractor, EOR, Manufacturer Representative, Commissioning Agent, and the OAR to validate the location of lighting control system components, including daylight, vacancy, motion sensors. Sensors shall be located based on manufacturer's recommendations.
- E. Systems components shall be Title 24 compliant and listed as California Energy Commission approved products.

1.04 WARRANTY

- A. Manufacturer shall provide a three-year material warranty.
- B. Installer shall provide a two-year installation warranty.

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1.05 TRAINING

- A. Provide a competent instructor who is factory trained and has comprehensive knowledge of system components and operations to provide full instructions to designated personnel in the system operation, maintenance, and programming. Training shall be specifically oriented to installed equipment and systems.
- B. Training shall include system overview, time schedules, override commands, emergency operation, and programming and report generation for school based non-technical personnel.
- C. Provide an eight hours OWNER's personnel and Maintenance and Operations technical employees training session; this training session shall cover and provide the following:
 - 1. As-built drawings of System layouts and point to point connection diagrams.
 - 2. System components cut sheets.
 - 3. Operations and maintenance data.
 - 4. Programmer and maintenance training: database entry; trend logs application programs, diagnostic routines, reporting, failure recovery and calibration, and expose the trainees to system's features, components, system architecture, operations, programming, report generation, communications, reading and interpreting alarms, and any other pertinent information required for the operations and maintenance of the system.
 - 5. Training sessions shall accommodate a minimum of 20 persons and be facilitated at CONTRACTOR's training facility, which should be no more than 50 miles from the Project Site.
 - 6. Obtain OWNER's approval for training locations exceeding 50 miles. In such cases, the CONTRACTOR shall be responsible for transportation expenses.
 - 7. CONTRACTOR shall provide training computers for all attendees. Computers shall be ready for live training sessions.
 - 8. Instructor(s) shall give the trainees the opportunity to practice on simulated and actual (installed) systems.
- D. The training session shall have an itemized agenda covering all aspects of the training to be covered in the sessions. CONTRACTOR shall obtain agendas approval from OWNER and Commissioning Agent.

1.06 SYSTEM REQUIREMENTS

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- A. The lighting controls shall be a centralized system furnished with digital room controllers, capable of working as a network system that communicates via common data line (s).
- B. The system shall be furnished with transformers, control electronics, hardware, resident software and complete programming, occupancy sensors, constant light controllers, exterior light sensors, photocells, digital and analog switches, dimmer switches, conduit and wiring for a complete and functional installation.
 - 1. Software shall be resident within the lighting control system.
 - 2. System shall provide local access to programming functions at the master Lighting Control Panel (LCP) and remote access to programming functions via computers or other intelligent communication devices running an industry standard internet browser.
 - 3. System software shall provide real time status of all components and ancillary devices.
 - 4. For on-site access, the lighting control system shall have a built-in touchscreen allowing authorized access to localized control and programming
- C. Areas controlled by a motion sensor; such as rooms with one luminaire and emergency fixtures designed to operate 24 hours a day, seven days a week shall be programmed accordingly.
- D. The system shall have a server built into the master LCP. The server shall effectively work/operate through HTML pages from any authorized workstation.
 - 1. WEB front end shall be accessible over an OWNER provided Ethernet 10/100 Mbps to the local area network.
 - 2. Protocol shall be TCP/IP and allow either http (hypertext transfer protocol) or https (hypertext transfer protocol secured) connections.
- E. Desktop computers are not part of this section and will be provided by others. Non-networked, non-digital, non-server capable systems are not acceptable.
- F. Lighting control system shall be able to be monitored and take commands from a remote Personal Computer (PC); should the remote PC go off-line system programming uploaded to the lighting control system shall continue to operate as intended. Systems requiring an on-line PC or server for normal operation are not acceptable
- G. Devices shall be factory pre-addressed but be able to be field addressable also. Systems requiring field addressing only are not acceptable.

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- H. Programs, schedules, time of day, etcetera, shall be held in non-volatile memory at power failure. At restoration of power, lighting control system shall implement programs required by current time and date.
- I. System shall be capable of flashing lighting OFF/ON for any relay or lighting zone prior to the lights beings turned OFF. The warning interval time between the flash and the final lights off signal shall be definable for each zone. Occupant shall be able to override any scheduled OFF sweep using local lighting zone override switches within the zone or occupied space. Occupant override time shall be pre-programmed not to exceed two hours, or current California Title 24 requirements.
- J. The system shall be capable of implementing ON, OFF, Raise (dimming), and Lower (dimming), and preset commands, group or zone by means of devices connected to programmable inputs in the lighting control system.
- K. Programming and scheduling shall be done at the master LCP and/or remotely via the Internet. Remote connections shall function in real time control and real time feedback.
- L. System may consist of centralized relay panels, room controllers, digital switches, analog switches, photocells, motion sensors, lumen control devices, dimmer switches, and various digital interfaces. All system components, including remote and centralized room controllers, digital switches, etc. shall operate and be integrated as a network.
 - 1. Remote Room Controllers (RRC) shall control lighting fixtures in that area or space.
 - 2. The RRC shall provide power to ancillary and control devices, such as occupancy sensors, and take input from controlling devices, such as daylight and occupancy/vacancy sensors.
 - 3. RRC's shall be capable of taking inputs from OWNER specification line voltage type switches.
- M. RRC, switches, photocells and occupancy sensors, and ancillary devices and components shall be integrated per lighting control manufacturer's instructions.
- N. Location of devices and relay panels or relay controllers installed above ceilings shall be identified with a printed label attached to ceiling elements. Locate label directly below equipment location.

1.07 LIGHTING CONTROL OVERVIEW-BY AREA CONTROLLED

- A. Rooms:

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1. The rooms shall be controlled by a combination of vacancy sensors, daylight controllers and dimmers switches.
 - a. The vacancy sensor is to automatically switch lights OFF when the room is not occupied for 15 minutes.
 - b. Daylight controls shall automatically adjust light intensity according to the natural light level in the room to maintain a uniform level of lighting in the range of 30-50 foot-candles.
 - c. The daylight sensors shall be enabled and disabled by the vacancy sensors to ensure daylight-controlled lights never automatically turn ON when room is unoccupied. The lighting control system shall allow an authorized person to disable the daylight sensors and dimming controls.
 - d. Wall switches, and dimmers are to manually switch lights ON and OFF. Switches shall comply with the operational requirements of the current T24, and include location of device, accessibility and override capability.
 - e. Quiet time switch is to temporarily bypass the occupancy sensors for a pre-programmed period of one hour, or as indicated on drawings.
- B. Corridors and Open Areas:
 1. Corridors and other common areas are to be controlled by a combination of programmable low voltage keyed switches and time schedules supplied by the networked lighting control system.
 - a. Low voltage keyed switches are operable 24 hours a day and are to manually switch lights ON and OFF.
 - b. The central timer is to automatically sweep lights OFF after hours and provide scheduling capability where and when occupancy sensors are not used.
 - c. Interior corridors require occupancy sensors.
- C. Custodial, Unsupervised and Equipment Rooms:
 1. Provide occupancy sensors with automatic on-off capability in addition to manual switches, and programming features indicated on plans. These sensors shall turn off the lights in the room via 15 minutes pre-set programmable interval after the room has been vacated.
- D. Exterior Security Lights:

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1. Program exterior wall packs and security lights to be controlled via exterior light sensors, and time switches as indicated on drawings.
 - a. Program lights to ON state when natural lighting is below 5 foot-candles
 - b. Program lights to OFF when natural light level is greater than 5 foot-candles.

- E. Exterior, Non-Security Lights:
 1. Exterior non-security lighting in parking lots, corridors and pathways, and decorative lights shall be controlled via exterior light sensor working in conjunction with programmable controlled time schedules via the lighting control system.
 - a. Program lights to ON state when natural lighting is below 5 foot-candles, and when scheduled time is set to ON.
 - b. Program lights to OFF state when natural light level is greater than 5 foot-candles, and when scheduled time is set to OFF.

- F. Restrooms:
 1. Student Restroom and Lactation Room Lighting and Exhaust Fans (Fans interlocked with lights):
 - a. Restroom lights shall be controlled from the lighting control panel via assigned relays.
 - b. Provide by-pass lock type, vandal resistance key operated switch adjacent to the door, and ceiling mounted occupancy sensors for on/off controls.
 - c. The sensor shall turn off the lights via a programmable pre-set 15 minutes interval, after the room has been vacated.
 2. Staff Restrooms Lights and Exhaust Fans (Fans interlocked with lights):
 - a. Restrooms lights and fan shall be controlled from the lighting control panel via assigned relays.
 - b. Provide ceiling mounted occupancy sensors, and by-pass toggle switches for system override adjacent to the door.

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- c. The sensor shall turn off the lights via a programmable pre-set 15 minutes interval, after the room has been vacated.

G. Emergency Lighting:

- 1. Provide emergency lighting controls circuitry to achieve override or bypass of manually operated switches, lighting control systems, dimmers and occupancy sensors during power failures.
- 2. Each area of luminaries or groups of luminaries shall be equipped with and be controlled by a UL924 listed emergency lighting control unit to allow the detection of localized power failures.

PART 2 - PRODUCTS

2.01. CENTRAL LIGHTING CONTROL PANELS

- A. Central Lighting Control Panels (CLCP) shall be located in electrical closets.
- B. Panels shall be surface or flush mounted type as indicated on Drawings, with a hinged door assembly. Doors shall be furnished with flush type locks, spring latching, Corbin locks for metal doors, keyed to Corbin No. 60 keys. Panels shall include the following components or features:
 - 1. Shall be preprogrammed and preassembled with control equipment and relays as indicated on the lighting plans.
 - 2. Shall be equipped with suitable dividers separating Class 1 and Class 2 compartments, 120V and 277V compartments as well as "normal and emergency" compartments.
 - 3. Lighting control relays as indicated on Drawings. Provide 10 percent spare relays for centralized relay panels up to the maximum capacity of panel.
 - 4. Shall be equipped with a neatly typewritten schedule with number and name of rooms or areas served by the relay circuits. Room numbers and names used shall be determined at the Project site and may not be those indicated on Drawings. Schedule shall indicate panel designation and voltage and shall be mounted in a frame under transparent plastic 1/32-inch-thick on inside of panel cabinet.
 - 5. Each panel shall be rated for 120 or 277 VAC.
 - 6. Shall be preassembled, preprogrammed and include relays capable of switching 20 amps lighting loads for 120 or 277 VAC.

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7. Central lighting control panels, remote lighting control panels, relays, low voltage switches, interior light sensors, exterior light sensors, and associated control electronics shall be furnished by Lighting Control and Design (LC & D), Douglas Lighting Controls, or equal.
8. Approved products: Douglas Dialog Series, LC & D #GR-2400 series, or equal.

2.02. REMOTE ROOM CONTROLLERS

- A. Remote Room Controllers (RRC) shall be mounted in the ceiling space as indicated on plans.
 1. Each RRC shall be connected to the network lighting control system using manufacturer's recommended wiring method and configuration.
 2. Provide a printed label "RLCP" to the T-bar grid below the RRC".
 3. Approved products: LC&D GR-2404 Series or Douglas WRC-4244.
- B. Each RRC shall contain the following hardware features:
 1. Digital dataline switch inputs.
 2. 12 VDC and 24 VDC inputs for occupancy sensors requiring DC voltage for analog occupancy sensors, or Digital dataline type inputs for occupancy and light sensors.
- C. Switches shall be capable of switching individual relays, local groups of relays within the panel or global groups of relays system wide. Each switch shall be configured to be ON, OFF, RAISE, LOWER, or Toggle.
- D. The RRC shall digital dataline occupancy sensors. The sensors shall be configured for OFF only or ON/OFF switching scenarios.
- E. Photo sensor shall be linked with occupancy sensing so that when light levels are high enough, the occupancy/vacancy sensor will not switch the photo-controlled relays ON.

2.03 RELAYS

- A. Relays shall be warranted for a minimum of three-years.
- B. Relays shall be individually added or replaced. Lighting control systems incapable of replacing individual relays are not acceptable.

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- C. Each lighting control relay shall be capable of controlling LED sources.
- D. Approved Products:
 - 1. Single Pole: Douglas WR-6161, LC&D SL-277-NC, or equal.
 - 2. Double Pole: Douglas WR-6172, LC&D SL-480-NC, or equal.

2.04 LOW VOLTAGE SWITCHES

- A. Low voltage switches shall be wired in compliance with manufactures requirements. Digital switches shall be part of the lighting control system network.
 - 1. Provide stainless steel switch plates, unless noted otherwise in construction documents.
 - 2. Approved Products: LC&D Chelsea series, Douglas WSW-3500 series, or OWNER approved equal.
- B. Physical removal of any single switch shall have no effect on the communication between relay panels in the rest of the lighting control network. Lighting control systems requiring the continuous connection of all low voltage switches are not acceptable.
- C. Keyed switches shall be digital.
 - 1. Approved products: Douglas WSK-35XX Series, LC&D KS Series, or equal.
 - 2. Provide stainless steel switch plates, unless noted otherwise in construction documents.
- D. High abuse areas (common areas, Assembly, class Labs, etcetera) shall be controlled using a vandal resistant, touch sensitive high abuse switch and available with up to three buttons in a single gang. Multi gang versions shall also be available.
 - 1. Touch pads shall be stainless steel and capable of handling both high abuse and power wash cleaning crews' activities.
 - 2. Switches shall be digital or analog as indicted on plans.
 - 3. High abuse switch touch buttons shall control a single relay or group(s) of relays of the lighting control system.
 - 4. Touch buttons shall be controllable via programmed commands to enable or disable, ON, OFF, Toggle or Maintain operation functions. Programming shall be done locally or remotely.

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5. Touch pad(s) shall be identified as to function by an engraved label.

E. Switches must be capable of handling electrostatic discharges of at least 30,000 volts (1cm spark) without any interruption or failure in operation.

2.05 INTERIOR DAYLIGHT SENSORS

A. Interior daylight sensors shall cause light fixtures to brighten or dim to maintain pre-determined and uniform light levels.

B. The sensors shall permit any relay to switch at a unique light level and shall attempt to maintain a constant light level by switching individual relays ON or OFF as the ambient light level changes.

C. Controllers offering single set point controls are not acceptable.

D. Each interior daylight sensor shall continuously monitor the true light level and shall broadcast this level to lighting control network. Controllers requiring readings at the sensor head itself are not acceptable.

E. Each interior daylight sensor shall be fully adjustable via the lighting control software. Controllers requiring adjustments at the sensor head are not acceptable.

F. Provide daylight sensors in all rooms with windows. Refer to lighting plans to determine which switch legs are controlled by the daylight controller.

G. Approved Products: LC&D iPC Series, Douglas WPS-3711, Douglas WPP-INT, or equal.

2.06 EXTERIOR LIGHT SENSORS

A. One exterior light sensor shall permit different relays to switch at different light levels. Sensors offering less than 14 remotely settable trip points are not acceptable.

B. Exterior light sensor shall continuously monitor light levels and shall broadcast this level over the lighting control network. Exterior light sensor shall be fully adjustable via the networked lighting control system.

C. Sensors and controllers requiring adjustments at the sensor head are not acceptable.

D. Sensors shall be UL or NRTL listed for exterior application.

E. Approved products: Douglas WPS-3741B, LC&D PCO, or equal.

2.07 DIMMING CONTROLLER

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- A. Remote relay panels shall be capable of outputting 0V – 10V dimming signal for each relay provided in the remote room controller. LED Dimming drivers shall be controlled by industry standard 0V-10V control input.
- B. LED Drivers using proprietary control protocols shall not be acceptable.
- C. To maximize daylight harvesting and minimize disruption to occupants, each dimming output shall provide adjustment for baseline, start point, mid point, end point, trim fade up rate, fade down rate, time delay and enable/disable masking.
- D. Photocells settings must be remotely accessible.
- E. Systems that provide ON, OFF with Time Delay only and systems that do not provide remote accessibility are not acceptable.
- F. Mount photocells in locations indicated on plans and according to manufacturer's recommendations for daylight system type, open or closed loop. Trip points shall be able to be programmed and altered remotely via programming functions at the master Lighting Control Panel (LCP) and remote access to programming functions via computers or other intelligent communication devices.
- G. Photocells requiring manual trip point adjustment, or systems that provide local adjustment only are not acceptable.
- H. Photocells used for interior lighting control shall have multiple settings such as start-point, mid-point, off-point, fade-up rate, fade-down etc.
- I. Approved Products: Douglas WPS-3711, Douglas WPP-INT, LC&D iPC series, or equal.

2.08 OCCUPANCY SENSORS

- A. Occupancy Sensors:
 - 1. Ceiling-Mounted Dual Technology Sensors:
 - a. Sensors shall be dual technology infrared-ultrasonic capable of detecting presence in floor area to be controlled, by detecting Doppler shifts in transmitted ultrasound and infrared technology.
 - 1. ADI-Voice technology may be used in addition to the required infrared-ultrasonic features.
 - b. Detection shall be maintained when a person moves only within a maximum distance of 12 inches, in either a horizontal or vertical

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manner, at approximate speed of 12 inches per second. Lights shall not go off when a person is reading or writing while seated at a desk.

- c. Each sensor shall be furnished with a convenient shunt provision, which will enable a person to by-pass sensor in event of failure.
- d. Sensitivity shall not change more than ten percent in temperature range of 0 degrees F. to 120 degrees F., and in humidity range of ten percent to 80 percent. Sensitivity adjustment shall be provided for each technology.
- e. Time delay range shall be adjustable from 15 seconds to 15 minutes.
- f. Sensors power supply shall be provided by power pack, consisting of a transformer and contact closure relay in one package. Power output of transformer shall be capable of operating a minimum of two sensors.
- g. Approved products: Watt Stopper No. DT-200, similar as manufactured by Leviton, Sensor Switch, Unenco, or equal.

B. Dual Technology Passive Infrared Wall Switch Sensors with Daylight Controls:

- a. Sensors shall be capable of detecting presence in floor area to be controlled, by detecting changes in infrared-ultrasonic energy. Small movements shall be detected such as when a person is writing while seated at a desk.
- b. Passive infrared sensor shall utilize a dual-element sensor and a multi-element fresnel lens.
- c. Sensor shall be furnished with a daylight filter which ensures that sensor is insensitive to short-wavelength infrared waves, such as those emitted by the sun.
- d. Sensors shall be furnished with convenient bypass provisions, which enable lighting to be turned on in case of failure.
- e. Time delay range shall be adjustable from 15 seconds to 15 minutes.
- f. Sensitivity adjustment shall range from 0 (off) to ten (maximum).
- g. Adjustments and mounting hardware shall be concealed under a removable cover to prevent tampering with adjustments and hardware.
- h. Each sensor shall cover up to 800 square feet, with a field-of-view of 180 degrees.

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- i. Sensor shall be a completely self-contained control system.
- j. Power shall be provided via an internal transformer.
- k. Switching mechanism shall be a latching dry contact relay.
- l. Sensor shall be capable of switching from 30 to 1000 Watts, LED, incandescent or fluorescent light sources.
- m. Sensor shall be furnished with a daylight feature, adjustable from ten to 400 foot-candles, that maintains lighting off when a desired foot-candle level is present.
- n. Sensors shall be dual voltage, 120 volt and 277 Volt.
- o. Approved products: Watt Stopper No. WI 200, I 300, similar as manufactured by Leviton Sensor Switch, Unenco, or equal.

2.09 UNIT INVERTERS

- A. Unit Inverters shall be rapid start type consisting of emergency power packs designed to be installed in channels of new lighting fixtures.
- C. Power pack construction shall be of durable polycarbonate housing.
- D. Units shall be furnished with test switches and pilot lights.
- E. Units shall automatically power designated lamp(s) for 90 minutes of emergency service upon failure of utility power.
- F. Upon return of utility power, battery shall automatically recharge.
- G. Batteries shall be field-replaceable, sealed, rechargeable, spill-proof, maintenance-free nickel cadmium.
- H. High efficiency inverter/charger design shall include low-voltage disconnect to prevent deep discharge of battery and dual voltage designed for connection to either 120 or 277 volts. Chargers shall recharge fully discharged batteries to provide 90 minutes operation within 24 hours. Power pack shall not operate if shut off manually.
- I. An unconditional five-year warranty is required.
- J. Approved products: Dual-Lite UFO-5 Series, Bodine, Iota I series, Beghelli Luce, or equal.

2.10 INTERFACE TO BUILDING MANAGEMENT SYSTEM

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- A. When interface to the Building Management System is required, The lighting control system shall provide a BACnet/IP interface module that communicates with the BMS via a BACnet/IP network. (a collection of one or more IP sub networks (IP domains) that are assigned a single BACnet network number). Verify if interface to BMS is required.
- B. BACnet/IP interface module shall provide the capability for the BMS to:
 - 1. Communicate directly with each relay in the lighting control system network and each group used within the lighting control system.
 - 2. Monitor the status and status changes of each relay and each group.
- C. Install wiring and confirm operation of the lighting control BACnet/IP interface module per the lighting control manufacturer's instructions. Installing, wiring, and interfacing of BMS components to the lighting control system.

PART 3 – EXECUTION

3.01 GENERAL

- A. Lighting control system shall not be used for any other purpose other than its intended use and application.
- B. Provide required interconnections with other systems such as emergency power sources, fire alarm systems, and building management system as required or indicated on drawings.
- C. Installation shall meet or exceed standard practice of workmanship and quality.
- D. Drawings are diagrammatic in nature and indicate work to be provided, but do not provide means and methods, bends, transitions, or special fittings required to clear beams, girders or other work already in place. Investigate conditions where conduits are to be installed and furnished and install required fittings.

3.02 INSTALLATION AND SET-UP

- A. Verify that conduit for line voltage wires enters panel in line voltage areas and conduit for low-voltage control wires enters panel on low-voltage areas. Refer to manufacturer's drawings for location of line and low-voltage areas.
- B. Provide for digital type switches and make all connections according to lighting control manufacturer's requirements.

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- C. Central Lighting Control Panels and Remote Room Controllers shall be connected via a data line (Douglas uses a non-polarized two No. 18 and LC&D uses Cat5 four twisted pair cable, with RJ45 end connectors). Connect entire lighting control system per manufacturer's requirements. Do not exceed manufacturer's total data line length requirement.
- D. Panels shall be located so that they are readily accessible and not exposed to physical damage.
- E. Panel locations shall be furnished with enough working space around panels to comply with the California Electrical Code.
- F. Panels shall be securely fastened to the mounting surface by at least four points.
- G. Unused openings in the cabinet shall be effectively closed.
- H. Cabinets shall be grounded in accordance with Article 250 of the California Electrical Code, and manufacturer's recommendations.
- I. Lugs shall be suitable and listed for installation with the conductor being connected.
- J. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- K. Maintain the required bending radius of conductors inside cabinets.
- L. Clean cabinets of foreign material such as cement, plaster and paint.
- M. Distribute and arrange conductors neatly in the wiring gutters.
- N. Follow the manufacturer's torque values to tighten lugs.
- O. Before energizing the panelboard, the following steps shall be taken:
 - 1. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been furnished.
 - 2. Remove shipping blocks from component devices and the panel interior.
 - 3. Remove debris from panelboard interior.
- P. Follow manufacturers' instructions for installation.

3.03 OPERATING/SERVICE MANUALS

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- A. Service and Operation Manuals:
1. Submit operation and service manuals. Complete manuals shall be bound in flexible binders and data shall be typewritten or drafted.
 2. Record drawings: Provide (3) printed and one electronic copy on flush media of as built documents in latest version of ACAD of the entire system; including, floor plans with equipment, and devices layouts and wiring, interconnections with other systems, conduit and cable runs, programmed configurations, sequence of operations, system labeling codes, system passwords, and other pertinent information.
 3. Manuals shall include instructions necessary for proper operation and servicing of system and shall include complete wiring circuit diagrams of system, wiring destination schedules for circuits and replacement part numbers. Manuals shall include as-built cable Project site plot plans and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on cables. Programming forms of systems shall be submitted with complete information.

3.04 PROTECTION

- A. Protect all work, equipment and components of the lighting control system until Substantial Completion.

3.05 TESTING

- A. Set-up, commissioning and testing of the lighting control system, and OWNER instruction shall include:
1. Confirmation of system programming.
 2. Confirmation of operation of individual relays, switches, occupancy sensors and daylight sensors.
 3. Operation of system's features under normal and emergency operations.
 4. Before energizing check and demonstrate in the presence of the Project Inspector that cables and wire connections are free from short circuits, ground faults, and that there is continuity, and necessary insulation.
 5. Confirm system operations and functionality.
 6. Check system interface response to other systems such as fire alarm and emergency power system conditions.

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3.06 SPARE PARTS

- A. Provide a minimum of five percent spare parts of each type of relay, sensors, switches, and peripheral devices.

3.07 CLEANUP

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

END OF SECTION

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SECTION 26 12 00 - MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Single and three phase individually mounted transformers and the transformer component of unit substation equipment operating at a voltage greater than 600 volts, for power and lighting applications. and medium-voltage transformers.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 05 00: Common Work Results for Electrical.
 - 3. Section 26 05 13: Basic Electrical Materials and Methods.
 - 4. Section 26 05 26: Grounding and Bonding.
 - 5. Section 26 05 33: Raceways, Boxes, Fittings, and Supports.
 - 6. Section 26 05 16: Medium Voltage Cables, Splices and Terminations.
 - 7. Section 26 13 16: Medium-Voltage Metal-Enclosed Load Interrupter.
- C. Codes and Applicable Standards: Transformers shall comply with all applicable IEEE, ANSI, and NEMA Standards for medium voltage Dry-Type Transformers including those with solid cast and/or resin-encapsulated windings.
 - 1. Department of Energy Policy Act of 2005 - Public Law 109-58.
 - 2. California Energy Commission Appliance Efficiency Regulations.
 - 3. California Building Code.
 - 4. ANSI/NFPA70, National Electrical Code, as adopted by the State of California.
 - 5. IEEE C57.12.01, General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid Cast and Resin-Encapsulated Windings

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6. ANSI C57.12.51, Requirements for Ventilated Dry-Type Power Transformers, 501 KVA and Larger, Three-Phase with High-Voltage 601 to 34 500 Volts, Low Voltage 208Y/120 to 4160 Volts
7. ANSI C57.12.55, Dry-Type Transformers in Unit Installations, Including Unit Substations - Conformance Standard
8. ANSI/IEEE C57.98, Impulse Tests, Guide for Transformer (Appendix to ANSI/IEEE C57.12.90)
9. IEEE C57.12.91, Test Code for Dry-Type Distribution and Power Transformers
10. IEEE C57.94, Recommended Practice for Installation, Application, Operation and Maintenance of Dry-Type General Purpose Distribution and Power Transformers
11. IEEE C57.96, Guide for Loading Dry-Type Distribution and Power Transformers
12. NEMA ST 20, Dry Type Transformers for General Applications
13. OSHA 29 CFR 1910.145 Specification for Accident Prevention Signs and Tags

D. ACRONYMS

ANSI	American National Standards Institute
OAR	Owner Authorized Representative
CEC	California Electrical Code
EOR	Engineer of Record
IBC	International Building Code
IEEE	Institute of Electrical and Electronics Engineers
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association

1.02 SUBMITTALS

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- A. Provide in accordance with Division 01.
- B. Shop Drawings: Include make, catalog number, dimensions, weight, KVA rating, percent impedance, finish, type, insulation class, design temperature and taps provided. Include regulation at 80 percent and 100 percent of full load, no-load loss, full-load loss, percent efficiency, percent impedance, noise level and continuous capacity rating. Provide point to point connection diagrams and elevation details.
- C. Provide manufacturer's data and inspection report that confirm compliance with the requirements of this section.
- D. Provide a copy of the following test reports: Tests shall be performed on transformers, in accordance with IEEE C57.12.91. EOR shall review the reports for conformance with the specified criteria and applicable standards. Submit one copy for each set of shop drawings:
 - 1. No-Load Losses.
 - 2. Load Losses: Measurements shall be taken at multiple levels and plotted to show compliance with the specified criteria and applicable standards.
 - 3. Turn Ratio.
 - 4. Applied Potential (High-Pot).
 - 5. Temperature Rise.
 - 6. Induced Potential.
 - 7. Sound Level.
 - 8. Basic Impulse Insulation level (BIL).
 - 9. Impedance.
 - 10. Polarity and Phase Rotation.
 - 11. Exciting Current.
 - 12. Certified Test Report.
- E. Installation Instructions: Submit manufacturer's complete package of printed installation instructions and connection diagrams.

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1.03 WARRANTY

- A. Transformers shall be warranted to be free from defects in materials, fabrication and execution for three years from date of substantial completion.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Transformers manufactured by Square D, Siemens, General Electric, PowerSmiths, MGM, and Cutler Hammer or equal.
- B. Transformers shall be substation type with side-wall primary and secondary terminations.
- C. Transformers shall be solid-cast, dry-type construction, mounted in a ventilated enclosure. There shall be no exposed screws, bolts, or other fastening devices that are externally removable.
- D. There shall be no openings through which foreign objects such as sticks, rods, wires, or the like might contact live parts. Screen ventilated spaces from rodents and foreign objects. Provide means for padlocking compartment door(s). Padlocked locations shall be equipped with Corbin CAT 60 padlocks.
- E. The average temperature rise of the transformer windings shall not exceed 80 degrees C when the transformer is operated at full nameplate rating. The transformer shall be capable of carrying 100 percent of the nameplate KVA rating in a 40 degrees C maximum, 30 degrees C average ambient as defined by IEEE C57.12.01.
- F. Terminations shall be side-wall mounted for close-coupling to high and low voltage switchgear sections (Primary connection points shall have NEMA standard termination lug holes).
- G. The transformer shall be rated as indicated on Drawings. The transformer shall be furnished with two 2 ½ percent full capacity above normal and two 2 ½ percent full capability below normal primary taps. Sound level shall not exceed the maximum specified by NEMA TR-1 for the applicable KVA size of the transformer.
- H. Primary and secondary windings shall be constructed of copper conductors. Primary and secondary phase windings for each phase shall each be separately cast as one rigid tubular coil, and arranged coaxially. Each cast coil shall be fully reinforced with glass cloth, and cast under vacuum to provide complete, void-free resin impregnation throughout the entire insulation system.

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- I. The transformer core shall be constructed of high grade, grain-oriented silicone steel laminations, with high magnetic permeability. Magnetic flux density is to be kept well below the saturation point. The core shall be cruciform in shape, with mitered joints to keep core losses, excitation current and noise level at a minimum. The outside surfaces of the core shall be protected against corrosion by painting with a suitable coating after assembly. Core dipping is not permitted.
- J. The enclosure shall be constructed of heavy-gage sheet steel, minimum 12-gage. Ventilating openings shall be in accordance with NEMA and CEC standards for ventilated enclosures. The cabinet shall be furnished with a minimum of four hinged doors. The cabinet shall be furnished with door sills for easy panel installation.
 - a. Outdoor units shall be furnished with a NEMA 3R enclosure.
- K. The base shall be constructed to permit rolling or skidding in any direction, and shall be furnished with jacking pads designed to be flush with the transformer enclosure.
- L. Transformers shall be free of partial discharge up to at least 1.2 times the rated line to ground voltage. High voltage coils shall be subjected to a partial discharge test to verify its partial discharge.
- M. Each transformer to be installed under this section shall be sound tested at the factory. Contractor shall provide two copies of transformers tests reports for EOR review.
 - a. Transformers up to 35 KVA shall be less than 40 decibels. Transformers 36 KVA or more shall be a minimum of five decibels below NEMA standards per unit.
- N. Transformers shall be provided with vibration dampers consisting of Korfund, Mason, or Caldynamics rubber pad and Elastorib sheeting. Size and number of shock mounts shall be in accordance with manufacturer's recommendations.
- O. Transformers shall be UL listed.
- P. Verify all points of connection with the manufacturer's requirements, instructions, or recommendations prior to installation. Actual dimensions, weights, clearances and installation requirements shall be verified and coordinated prior to commencement of work.
- Q. Provide and install OSHA/CAL OSHA mandated bilingual (English and Spanish) hazard warning signs on all accessible equipment sides containing access doors and/or panels. The signs shall be a minimum of 14 inch by 10 inch in size and be constructed on an aluminum backing. Design of signs shall be OSHA 29 CFR 1910.145 compliant with the words DANGER HIGH VOLTAGE KEEP OUT.

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Signs shall be attached to its intended mounting surface with a minimum of ten evenly distributed pop rivets for metal surfaces or tamper resistant screws on metal or other surfaces provided that protruding portion of screws if any is covered to eliminate the possibility of an injury.

PART 3 - EXECUTION

3.01 DELIVERY AND STORAGE

- A. Deliver, storage, protect and handle products in accordance with the manufacturer's recommendations.

3.02 INSTALLATION

- A. Transformer core frame shall be installed level on shock absorbing pads with enclosure.
- B. Mounting bolts shall be extended into pads only and shall not be in direct contact with building structural members. Install transformer ventilation openings not closer than six inches from any wall surface. Installation shall comply with CBC seismic design requirements.
- C. Flexible jumpers shall be installed for grounding continuity from enclosure to conduits or bus ducts where required.
- D. Transformers installed outdoors or below grade shall be installed on concrete pads as described under Section 03 3000: Cast-In-Place Concrete and as detailed in Drawings. Anchored bolts shall be tested to withstand 100 foot-pounds torque.
- E. Install according to manufacturer's installation instructions.

3.03 VOLTAGE CHECK

- A. Set taps on transformers as required providing satisfactory operating voltages with present loads energized, including new loads and any existing loads.
- B. Provide instruments and accessories required to perform testing.
- C. Follow manufacturer's instructions for checking output voltage and voltage tap changing.

3.04 PROTECTION

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

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3.05 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.
- B. Repair scratched or marred surfaces affected during the execution of this work. Repaired surfaces shall match original finish.
- C. Manufacturer to provide touch-up paint with delivery.

END OF SECTION

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SECTION 26 13 16 - MEDIUM-VOLTAGE METAL-ENCLOSED LOAD INTERRUPTER

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

Medium voltage load interrupter metal enclosed switchgear, single or multiple section line-ups.

B. Related Requirements:

1. Division 01 General Requirements.
2. Section 03 30 00: Cast-In-Place Concrete.
3. Section 26 05 00: Common Work Results for Electrical.
4. Section 26 05 13: Basic Electrical Materials and Methods.
5. Section 26 05 16: Medium-Voltage Cables, Splices and Terminations.
6. Section 26 05 26: Grounding and Bonding.
7. Section 26 05 19: Low-Voltage Wires (600 Volt AC).
8. Section 26 10 00: Service Entrance.
9. Section 26 11 00 Load Center Unit Substations.
10. Section 26 12 00: Medium-Voltage Transformers.
11. Section 26 13 16: Medium-Voltage Metal-Enclosed Load Interrupter.
12. Section 26 24 13: Switchboards.
13. Section 31 23 13 Excavation, and Fill.

C. Related Standards:

1. ANSI C37.57 – Metal-Enclosed Interrupter Switchgear Assemblies - Conformance Testing.
2. ANSI C37.58 – Indoor AC Medium-Voltage Switches for Use in Metal-Enclosed Switchgear - Conformance Test Procedures.

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3. ANSI C37.20.3 – Standard for Metal-Enclosed Interrupter Switchgear (1 kV–38 kV).
4. IEEE-ANSI C37.22 – Preferred Ratings and Related Required Capabilities for Indoor AC Medium-Voltage Switches Used in Metal-Enclosed Switchgear.
5. IEEE 551 – Recommended Practice for Calculating AC Short-Circuit Currents in Industrial and Commercial Power Systems.
6. IEEE 1584 – Performing Arc-Flash Hazard Calculations.
7. IEEE 3002 – Recommended Practice for Conducting Short-Circuit Studies and Analysis of Industrial and Commercial Power Systems
8. NEMA SG5 – Power Switchgear Assemblies
9. NEMA SG6 – Power Switching Equipment.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. List of Materials: Submit a complete list of proposed materials.
- C. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of ancillary components fitting suspension and fastening section(s) in place. Provide wiring diagrams for power distribution and connections.
 1. Include a front elevation indicating dimensions and locations of equipment, make, kind and size or capacity of equipment and bussing, barriers, nameplate inscriptions, finish, total weight and size, and locations and sizes of anchor bolts.
- D. Prior to start of construction; provide copies of required test reports, proof of UL listing and compliance with IEEE and ANSI applicable industry standards.
- E. Installation Instructions: Submit manufacturer's written installation instructions including recommendations for handling, protection, and storage of equipment.
- F. Submit Fault Current, Coordination, and Arc-Flash reports based on installed conditions and equipment.

1.03 SUBSTITUTIONS

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- A. Material and products substations that deviate from these requirements shall not be accepted without written approval from OWNER'S Design Standards Section and Maintenance and Operations Technical Unit. When deviating or substituting equipment, the CONTRACTOR shall submit a substitution request form that states reasons for the request and benefits to OWNER; as well as compliance with all applicable codes and industry standards.

1.04 QUALITY ASSURANCE

- A. Equipment shall be tested and approved in accordance with applicable industry standards including those listed under article 1.02.
- B. Provide copies of equipment tests for metal-enclosed interrupter switchgear (ANSI), and NEMA SG6 power switching equipment.
- C. Equipment shall comply with California Electrical Code.
- D. CONTRACTOR shall submit proof that personnel working in the installation are properly trained and certified for working/ installing medium voltage power distribution equipment.
- E. Two weeks prior to final inspection, submit the following:
 - 1. Certification by the manufacturer that installed equipment conforms to the requirements of the drawings and specifications.
 - 2. Certification by the CONTRACTOR that equipment has been properly installed, adjusted, and tested.

1.05 WARRANTY

- A. Provide the following warranties:
 - 1. Manufacturer shall provide five-years material warranty.
 - 2. CONTRACTOR shall provide two-years installation warranty.

PART 2 - PRODUCTS

2.01 LOAD INTERRUPTER SWITCHGEAR

- A. Switches shall be quick-make, quick-break, three-pole, two-position with a stored energy spring mechanism to provide quick switch operation independent of the handle speed. A viewing window shall be installed in switch enclosure and located to enable visible inspection of switch poles from outside enclosure.

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- B. Complete metal enclosed switchgear shall be rated as indicated on Drawings with fault close; momentary ratings capable of withstanding short-circuit stresses.
- C. High-voltage fuses and non-disconnecting fuse mountings shall be accessible only through a separate door mechanically interlocked with load break switch, to insure the switch is in open position when fuses are accessible. A key interlocking system shall also be provided to prevent fuse access door from being opened unless switch is open, and to prevent switch from being closed unless fuse access door is closed. Switch designs with full height fuse access doors shall have a solid barrier covering area of main cross bus and/or line side of switch. Metal screen barriers are not permitted. Energized parts shall not be within normal reach of opened doorway. Four single full-length inter-phase barriers shall isolate three phases of the switch from each other and from enclosures. Fuses shall be current limiting type of self-contained design to limit available fault current stresses on system. Fuses shall be affixed in position with provisions for removal and replacement from front of gear without use of special tools. Provisions for padlocking in open and closed position shall be provided.
- D. Utility company metering section shall be furnished with mounting and wiring instrument transformers and meters, as required by the serving utility company.
- E. Enclosure frame and internal barriers shall be fabricated of code gage and finished with two coats of medium gray, ANSI No. 451, paint applied over a rust-inhibiting phosphate primer.
- F. Power Distribution System Reports: The required reports shall be performed using an industry standards software such as SKM System Analysis Inc., ETAP Powering Success, EasyPower, or District approved equal. The following information must be submitted:
 - 1. CONTRACTOR shall provide a complete selective coordination report of the installed power distribution system breakers and disconnects in compliance with applicable codes and IEEE standard.
 - 2. CONTRACTOR shall provide an Arc-Flash study report in accordance to code and applicable IEEE standards. The report shall indicate trip times for protective device(s) settings, arcing fault current values, and incident energy and flash boundaries. Report shall indicate clothing requirements for each piece of equipment.
 - 3. CONTRACTOR shall provide a Short Circuit Report of the installed power distribution system in compliance with codes and applicable IEEE Standards.

2.02 SWITCHGEAR CONSTRUCTION

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- A. Switch bays shall be separately constructed cubicles assembled to form rigid freestanding units. Adjacent bays shall be securely bolted together to form an integrated rigid structure. Top and rear covers shall be removable. Individual units shall be braced to prevent distortion. Installation shall adhere to seismic requirements of CBC.
- B. Provisions shall be furnished to allow for convenient extension of both main bus and ground bus to adjacent bays, which may be added in future. Main crossover bus is to be furnished and supported from top of enclosure on NEMA glass insulators. Ground bus shall run continuously through entire line-up and shall be securely fastened to the steel frame of each bay.
- C. Metal enclosed gear shall be fully assembled and tested at factory prior to shipment. Large line-ups shall be split to permit normal shipping and handling as well as for ease of installation at the Project site.
- D. Outdoor units shall be furnished in NEMA 3R enclosures designed with sloped drip-proof roofs. Cubicles shall be provided with door-in-door construction. Outer doors shall open to normal switch doors and operating handles. Switch-operating handles shall not be exposed to weather and will be operable regardless of weather conditions. Provide the front with a bulkhead type door along with three-point latch and vault type handle with provisions for padlocking. Cubicles are to be designed to allow front and rear access and do not require routing of line side or load side connections in front of switch/fuse compartment. Padlocks shall be provided for doors and keyed to Corbin No. 60 keys.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Cable terminations shall be as indicated in Section 26 05 16 - Medium-Voltage Cables, Splices, and Terminations.
- B. Furnish Spare Fuses: One spare fuse shall be furnished for each fusible switch installed. Spare fuse shall be of type and rating as those installed.
- C. Where free-standing equipment is installed at exterior locations or in locations below grade, concrete pads shall be provided as described under Section 03 3000: Cast-In-Place Concrete. Anchor bolts for freestanding equipment shall be designed to meet code seismic requirements. Equipment shall be anchored to new slabs with four ½ inch by 3 ½-inch expansion bolts per section; ½ inch anchored bolts shall be tested to withstand 100 foot-pounds of torque (Switchgear must be installed "Level" to ensure all doors open and close without being forced).

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- D. Follow manufacturer's instructions for receiving, handling, storage and installation of switchgears.
- E. Provide two sets of manufacture's recommended service and maintenance documents.

3.02 PROTECTION

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

3.03 CLEANUP

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

END OF SECTION

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SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: This specification covers single-phase and three-phase general purpose individually mounted dry-type transformers, 600 V maximum, for power and lighting applications. It includes transformers as specified and as indicated on Drawings.
- B. Work, material or equipment shall comply with the codes, ordinances and regulations of the local government having jurisdiction, including the regulations of serving utilities and any participating government agencies having jurisdiction.
- C. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 05 00: Common Work Results for Electrical.
 - 3. Section 26 05 13: Basic Electrical Materials and Methods.
 - 4. Section 26 05 26: Grounding and Bonding.
 - 5. Section 26 05 19: Low-Voltage Wires (600 Volts AC)
 - 6. Section 26 05 33: Raceways and Boxes, Fittings and Supports.
 - 7. Section 26 08 00: Electrical Systems Commissioning.
 - 8. Section 26 26 00: Power Distribution Units.
 - 9. Division 27: Communications.
- D. Codes and Applicable standards: Products and installation shall meet or exceed the latest edition of the following standards.
 - 1. ANSI/IEEE C57.96, Distribution and Power Transformers, Guide for Loading Dry-Type Transformers; Appendix to ANSI C57.12 Standards.
 - 2. Department of Energy, Energy Act of 2005.

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3. International Electrical Code adopted by the State of California.
 4. ANSI/NEMA 250 Enclosure for Electrical Equipment (1000 Volts Maximum).
 5. IEEE C57.12.91, Test Code for Dry-Type Distribution and Power Transformers.
 6. IEEE C57.110 – IEEE Recommended Practice for establishing liquid-filled and dry-type power and distribution transformer capability when supplying nonsinusoidal load currents.
 7. 1100-IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
 8. NEMA standard 20, Dry-Type Transformers for General applications.
 9. UL 506, Specialty Transformers.
 10. UL 1561, Dry-Type General Purpose and Power Transformers.
 11. NEMA TP-1, Guide for Determining Energy Efficiency for Distribution Transformers.
 12. NEMA TP-2, Standard Test Method for Measuring the Energy Consumption of Distribution Transformers.
 13. NEMA TP-3, Standard for the Labeling of Distribution Transformer Efficiency.
 14. CSA 802.2-00 Minimum Efficiency Values for Dry Type Transformers
 15. California Building Code (CBC)
 16. Tri-axial shake test results conducted in accordance with AC156 test protocol.
 17. California Electric Code
- E. No requirement of these drawings and specifications shall be construed to void any of the provisions of the above standards. Any conflicts or changes required to the contract documents in order to obtain compliance with applicable codes shall be brought to the immediate attention of the Owner Authorized Representative by the CONTRACTOR.
- F. ACRONYMS

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ANSI	American National Standards Institute
AOR	Architect of Record
CEC	California Electrical Code
EOR	Engineer of Record
IBC	International Building Code
IEEE	Institute of Electrical and Electronics Engineers
NEC	National Electrical Code
NEMA	National Electrical manufacturers Association

1.02 DESIGN REQUIREMENTS

- A. Premium Efficiency transformers with internal losses at 35 percent loading reduced by 30 percent when using temperature and material correction factor to 75 degrees C per NEMA Standard TP1
- B. Load Mix: Transformer shall be UL 1561 listed to feed a mix of equipment load profiles such as computer without detracting or significant degradation of efficiency.
- C. The transformer shall be labeled with a K-13 Rating in accordance with UL 1561 35.21 and 34.2.
- D. Transformer shall be certified as required by the California Energy Commission, Title 20 – Appliance Efficiency Regulations, unless otherwise EXEMPT under 110.10(a).
- E. Construction: Windings shall be continuous wound copper with brazed or welded terminations.
 - 1. Insulation and Varnish Systems: Epoxy Polyester impregnation
 - 2. Terminals, including those for changing taps must be readily accessible by removing a front cover plate.
- F. Performance of transformers shall meet or exceed the requirements of applicable codes and standards, the DOE Energy Policy Act of 2005 - Public Law 109-58 and the latest requirements of the California Energy Commission Appliance Efficiency Regulations. In addition; transformers shall be designed to an

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efficiency standard higher than the lowest legal standard for the purpose of contributing to LEED Energy and Atmosphere (Optimized Energy Performance) and Utility Rebates.

- G. Transformers shall be self-cooled type with 220 degrees C. insulation and a maximum temperature rise of 130 degrees C. under continuous full load conditions with an ambient of 40 degrees C.
- H. Transformers shall be furnished with four 2.50 percent (two above and two below normal voltage) taps. Windings shall be of fire-resistant type, designed for natural convection cooling through normal air circulation.
- I. Core mounting frames and enclosures shall be of welded and bolted construction with sufficient mechanical strength and rigidity to withstand shipping, installation, and short circuit stresses.
- J. Enclosure cover plates shall be sheet steel, captive bolted to enclosure framework. Enclosure shall provide suitable ventilating openings with rodent-proof screens, NEMA 1 enclosure. Enclosure shall be provided with lifting lugs and jacking plates as required. Transformers installed outdoors shall be provided with weatherproof NEMA 3R enclosure and weatherproof kit.
 - 1. Submit rodent-proof screen sample for OWNER's approval.
- K. Transformers shall be furnished complete with mounting channels and mounting bolts. Metal parts, excepting cores and core mounting frames shall be furnished clean, rust-proofed, and provided with a coat of an inert primer.
- L. Transformers up to 35 KVA shall not exceed 40 decibels. Transformers 36 KVA or more shall be a minimum of 5 decibels below NEMA standards per unit. Transformers shall be provided with vibration dampers consisting of California Dynamic, Mason Industries, Korfund or equal neoprene mounting pad and Elastorib sheeting. Size and number of shock mounts shall be in accordance with manufacturer's recommendations.
- M. Transformers shall be UL listed.
- N. Each transformer to be installed under this section shall be sound tested at the factory. CONTRACTOR shall provide two copies of transformers tests reports for EOR's review.
- O. Equipment shown on drawings to scale is approximate only and based upon a general class of equipment specified. The CONTRACTOR shall verify dimensions and clearances prior to commencement of work.

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- P. Verify points of connection with the manufacturer's requirements, instructions, or recommendations prior to installation. Actual dimensions, weights, clearances and installation requirements shall be verified and coordinated by the CONTRACTOR.
- Q. K-rated transformers shall be type NL-UL.
1. Electrostatic shield.
 2. NLP series shall have a maximum sound level of 3 dB below NEMA standards.
 3. Double-size neutral terminal.
 4. Additional coil capacity to compensate for higher non-linear load loss.
 5. Heavy gage ventilated indoor enclosures (provide weather shields where installed indoors).
 6. K-rated transformers shall meet other requirements of this section.
- R. NLP-UL for projects where the non-linear loads as indicated on drawings and be equipped with the following features:
1. Electrostatic shield.
 2. NLP series shall have a maximum sound level of 3 dB below NEMA standards.
 3. Double-size neutral terminal.
 4. Additional coil capacity to compensate for higher non-linear load loss.
 5. Heavy gage ventilated indoor enclosures (provide weather shields where installed indoors).
 6. K-rated transformers shall meet other requirements of this section.

1.03 SUBMITTALS

- A. Provide submittals in accordance with Division 01.
- B. Shop Drawings: Include make, catalog number, dimensions, weight, KVA Rating, Percent Impedance, finish, type, insulation class, design temperature, sound levels, efficiency and taps provided. Include regulation at 80 percent and

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100 percent of full load, no-load loss, full-load loss, percent efficiency, percent impedance, noise level and continuous capacity rating.

- C. Provide manufacturers data and inspection report that confirms transformers compliance with UL 1561, DOE, and NL-UL or NLP-UL (Refer to 1.02.Q).
- D. Provide a connection schematic diagram.
- E. Provide the following tests reports: Project Inspector will review the reports for conformance with specified criteria, and compliance with the applicable standards. Submit one copy for each set of shop drawings being submitted.
 - 1. Load Losses: Measurements shall be taken at multiple load levels and plotted to show compliance with specifications and correlated to efficiency curve for the transformer size and type.
 - 2. Provide No-Load and Total Losses report.
 - 3. Applied Voltage.
 - 4. Temperature Rise.
 - 5. Induced Voltage.
 - 6. Sound Level.
 - 7. Impulse Test.
 - 8. Manufacturer's nonlinear load test representing real world load mix. Transformers not meeting this requirement shall not be installed.
- F. Submit harmonics test plan as follows:
 - 1. NEMA ST-20.
 - a. Open Circuit Test (no load losses):
 - 1) Use for both Linear and non-Linear.
 - 2) Measure Power.
 - b. Short Circuit Test (load losses):
 - 1) Short Primary Winding: Linear Test complete with linear profile through secondary winding.

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- c. Non-Linear Test.
 - 1) Complete with non-linear profile through secondary windings.
 - 2) Measure Power.
 - d. Provide data and graph efficiency:
 - 1) Graph-1 – Linear Loads 0 to 100 Percent Loads.
 - 2) Graph 2 – Non-Linear Profile K-13 0 to 100 Percent loads.
2. Test Plans measuring Power In and Power Out will not be accepted since procedures are not covered by any standard.

1.04 SUBSTITUTIONS

- A. Transformers that deviate from these requirements shall not be accepted without written approval from OWNER'S Design Standards and Maintenance and Operations Technical Units. When deviating or proposing substitutions the following information shall be submitted:
 - 1. Substitution request form substantiating reasons for the deviation and benefits to the OWNER.
 - 2. Proposed substitutions requests shall provide proof of compliance with transformers characteristics indicated in this specifications section.
- B. Submittals must comply with contract general provisions.

1.05 QUALITY ASSURANCE

- A. Installation shall be performed by State approved/ certified electricians.
- B. Transformers shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL), and in compliance with applicable industry standards and codes, including those mentioned under REFERENCES.
- C. Provide labor, engineering, design, testing, supervision, material and equipment required.
- D. Equipment shall be new and high quality. Manufacturer shall have been continuously manufacturing distribution transformers for at least 10 years.

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1.06 COMMISSIONING

- A. A Commissioning Services Provider (CxSP) retained by the OWNER will lead and provide Commissioning (Cx) of power distribution systems and assemblies, including submittal review, installation, testing, documentation, and training as indicated in section 26 08 00 – Electrical Systems Commissioning.
- B. CONTRACTOR shall follow the commissioning responsibilities stated in Section 01 91 13, General Commissioning Requirements.
- C. CONTRACTOR shall provide all tools and personnel, and perform start-up, prefunctional and functional performance testing in the presence of the OWNER's Commissioning Services Provider.

1.07 WARRANTY

- A. Provide a one-year labor warranty.
- B. Transformers shall be warranted to be free from defects in materials and fabrication for a period of three years from the date of substantial completion.
- C. Warranty period begins at project acceptance for beneficial occupancy.
- D. Warranty exclusions for third party components is not acceptable.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. Transformers manufactures Siemens, Square D, General Electric, PowerSmiths, MGM, Cutler Hammer, or equal approved by OWNER.
- B. There shall be no openings through which foreign objects such as sticks, rods, wires, or the like might enter and contact live parts. Provide means for padlocking compartment doors.
 - 1. Connection terminal points shall be bottom fed and located as far as possible below vent openings, or below top connections.
 - 2. Terminals shall be protected from external/foreign objects contact.

PART 3 - EXECUTION

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3.01 DELIVERY AND STORAGE

- A. Deliver, storage, protect and handle products in accordance with the manufacturer's recommendations.

3.02 INSTALLATION

- A. Transformer core frame shall be installed level on shock absorbing pads within enclosure. Comply with seismic requirements of CBC.
- B. Mounting bolts on floor mounted transformers shall be extended into pads only and shall not be in direct contact with building structural members.
- C. Flexible jumpers shall be installed for grounding continuity from enclosure to conduits or bus ducts where required.
- D. Transformers installed outdoors or below grade shall be mounted on concrete pads as specified in Section 03 30 00: Cast-In-Place Concrete.
- E. Install transformer ventilation openings not closer than 6 inches from wall surfaces.
- F. Do not install transformers in corrosive environments such as swimming pool pump and boiler rooms, or similar areas.

3.03 VOLTAGE CHECK

- A. Set taps on transformers to provide satisfactory operating voltages with present loads energized, including new loads and existing loads. A check shall be performed in the presence of the Project Inspector at a panel fed from each transformer, which is farthest from transformer. Voltages at transformers ranging from 118 to 122 volts inclusive, for 120-volt systems and proportionately equivalent for higher voltage systems are permitted.
- B. Provide instruments and accessories required to perform checks. Voltmeters shall be accurate within .075 percent or one percent and shall have scales permitting voltage readings to be performed on upper half of scale. Calibration of the meters shall be observed by the Project Inspector.
- C. Adjust transformer taps under full load operating conditions, to provide normal operating voltages at the loads.

3.04 PROTECTION

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

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3.05 CLEANUP

- A. Remove rubbish, debris and waste materials and legally dispose of off Project site.
- B. Repair scratched or marred surfaces affected during the execution of work. Repair surfaces shall match original finish.

END OF SECTION

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SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Main switchboard, including metering facilities required by the utility company.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 03 30 00: Cast-In-Place Concrete.
 - 3. Section 26 05 00: Common Work Results for Electrical.
 - 4. Section 26 05 13: Basic Electrical Materials and Methods.
 - 5. Section 26 05 26: Grounding and Bonding.
 - 6. Section 26 05 19: Low-Voltage Wires (600 Volt AC).
 - 7. Division 27: Communications.
 - 8. Division 28: Electronic Safety and Security.
- C. Related Industry Standards: The most current version of the following industry standards.
 - 1. ANSI/NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. California Electrical Code (CEC).
 - 3. IEEE C57.12.28 – Standard for Pad-Mounted equipment Enclosure Integrity.
 - 4. IEEE 551 - Recommended Practice for Calculating AC Short-Circuit Currents in Industrial and Commercial Power Systems.
 - 5. IEEE 1584 – Performing Arc-Flash Hazard Calculations.
 - 6. UL/ANSI 891 – Standard for Safety Switchboards.

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1.02 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Shop Drawings:
 - 1. Include a front elevation indicating dimensions and locations of equipment on switchboard, make, kind and size or capacity of equipment and bussing, location of each service conduit entering switchboard, barriers, nameplate inscriptions, finish, total weight and size of switchboard and locations and sizes of anchor bolts.
- C. Fault Current, Coordination and Arc-Flash Reports: the following reports shall be prepared using SKM Systems Analysis, ETAP Powering Success, EasyPower, or equal.
 - 1. Provide a short-circuit and coordination report signed and stamp by a registered electrical engineer. Studies shall be in accordance with applicable IEEE guidelines. Submit two copies of each study for review prior to ordering and installing equipment.
 - 2. Provide a system coordination report for main and branch circuit protective devices including transformers secondary protective devices. Study shall be recorded on log paper. The circuit protective devices shall be set based on the coordination study. A final written record of protective device settings shall be submitted.
 - 3. Provide a complete arch-flash report based on installed equipment, and feeders' sizes and lengths. Prepare the report in accordance with code requirements and IEEE 1584 standard. The report shall indicate trip times for protective device(s) settings, arcing fault current values, and incident energy and flash boundaries. The arc-flash report shall indicate clothing requirements for each piece of equipment.
 - 4. Provide installation detail and seismic anchorage notes for switchboards.

PART 2 - PRODUCTS

2.01 SWITCHBOARDS

- A. General Description: Switchboards shall be product of W.A. Benjamin Electric, Cuttler Hammer, General Electric, Siemens, or equal, and shall conform to the following requirements:

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1. Complete assembly, including steel framing and covers, bus system, and breaker mounting, shall satisfy applicable provisions of UL 891 and NEMA PB-2 and the California Electrical Code for low-voltage distribution switchboards. Switchboards shall be furnished with UL labels.
2. Switchboards shall be floor standing, dead front, dead rear, line bussed, front operated and connected, circuit-breaker type, unless otherwise indicated and shall contain equipment indicated and specified. Switchboard shall be complete with pull, service, and distribution sections as required.
3. Required equipment shall be enclosed in fully interchangeable die formed steel sectional cabinets with top and bottom plates and required braces and gussets so that cabinets will be absolutely rigid, plumb and uniform in size. Each cabinet shall be a separate and independent unit with assembly holes die-stamped or jig drilled; openings for interconnections shall be so placed that cabinet can be located in any position in assembly without drilling or cutting holes on job. Deliver switchboard to Project site in completely assembled sections and provide required assembly bolts and blanking plates. Front plates and doors shall be of not less than 12 gage furniture steel, completely removable, secured to cabinet with machine screws, with cup washers uniformly and symmetrically spaced. Provide hinged wire gutter covers for distribution sections. Equipment shall meet NEMA and UL standards.
4. Main circuit breaker or main fusible switch shall be as follows:
 - a. Main circuit breakers shall be automatic, one-piece molded-case, trip-free, common trip, quick-make, quick-break, thermal-magnetic with solid state trips, bolted to bus with frame size and trip ratings as indicated on drawings. Voltage, amperage ratings and number of poles shall be as indicated on breakers. Main breaker shall provide a minimum short-circuit interrupting capacity as determined by utility company. Provide shunt-trip and integral ground fault devices, as indicated on drawings. Breakers shall be furnished with lockout provisions.
 - b. Main fusible switch 800 amps or larger ampacity shall be high pressure contact, stored energy, quick-make/quick-break operation, with current limiting fuses, as indicated on Drawings. Provide shunt-trip, and integral ground fault devices, as indicated on Drawings. Were required, switches shall be motor operated and be furnished with an electrical trip mechanism piloted by output of ground fault sensing circuitry. Switch shall be furnished with lockout provisions.

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5. Feeder circuit breakers shall be automatic, one-piece molded-case, trip-free, common trip, quick-make, quick-break, thermal-magnetic or solid-state type bolted to bus, with handles clearly indicating tripped position. Breakers shall be furnished with a single handle with no tie-bar. Voltage, amperage, and number of poles shall be as indicated on Drawings. Breaker ratings shall be on handle or label. Breakers shall be furnished with lockout provisions approved by the State of California for padlocking and shall provide a minimum symmetrical short-circuit interrupting rating, as indicated on Drawings. Series rated circuit breaker combinations are not acceptable.
6. Fusible feeder switches shall be quick-make, quick-break, voltage rating and number of poles as indicated on Drawings, with visible blades and dual horsepower ratings. Switch handles shall physically indicate on and off positions. Switches shall be lockable only in off position and accept three industrial type heavy-duty padlocks. Switch covers and handles shall be interlocked to prevent opening in on position. Provide means to permit authorized personnel to release interlock for inspection purposes. Switches shall be equipped with Class R current limiting fuses or dual element fuse of size and capacity indicated on Drawings.
7. Utility metering provisions shall meet requirements of serving utility and shall be furnished with necessary fittings.
8. Provide switchboard silver-plated copper bus bars of same capacity as main breaker, or as indicated on Drawings, between current transformer and main section and distribution sections; also, full height of breaker space in distribution portions. Copper bus shall have current density of 1000A per square inch of cross section. Bus structure shall be free-fitted and shall have sufficient strength to withstand short-circuit as indicated on drawings. Connections shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices. Bus bar bracing shall be designed to withstand maximum available short-circuit current. Connections for cables to circuit breakers, switches and motor control devices shall be heavy-duty mechanical pressure type terminal lugs. Provide service cable lugs as required by utility company. Cables and internal wiring shall be supported with suitable cleats.
9. Switchboard distribution sections shall be furnished with full height bussing. Unused spaces shall be provided with blank covers. Switchboards, as complete units, shall be given single short-circuit current ratings by manufacturer. Such ratings shall be established by actual tests by manufacturer, in accordance with UL specifications, on equipment constructed similarly to the furnished switchboard.

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10. Provide a large nameplate identifying switchboard, indicating service voltage, originating power source, function and current rating. Nameplate shall be furnished with 3/16-inch engraved black letters on white background. Name plate shall be mechanically fastened to switchboard.
11. Provide labels for circuit breakers, disconnect switches, and or other disconnecting means in switchboards. Labels shall be a P-Touch type or equal, with a minimum width of 3/8 inch with black letters on white background. Label shall indicate name of load served, name or room number and if in different building, name of building. If equipment is installed in same room as source, label should indicate source name and "in this room".
12. Paint cabinets, framework and plates inside and out with one coat of rust-resistant metal primer and one coat of gray enamel, baked on, or lacquer sprayed on.
13. Manufacture boards according to reviewed Shop Drawings. Switchboard shall meet requirements of legally constituted authorities having jurisdiction, and respective serving utility.
14. Switchboards installed outdoors shall be weatherproof NEMA Type 3R enclosure. Enclosure construction shall be formed of code gage galvanized steel with ANSI No. 61 gray enamel finish. Heavy-duty, three-point latching, vault type door handles with padlocking provisions shall be furnished on doors. Padlocks shall be furnished keyed to Corbin No. 60 keys. Switchboards installed outdoors shall be specifically required to maintain service during extreme outdoor ambient temperatures of a minimum of 150 degrees Fahrenheit in NEMA Type 3R enclosures.
15. For grounded wye electrical service switchboards rated more than 150 volts, to ground and 1,000 amperes or more, provide ground fault protection for main protective device. Ground fault protection shall be UL listed, with ground sensor encircling phase conductors and neutral conductors integral with the main protective device. Provide testing of ground fault protection system by an independent recognized testing laboratory. Testing lab shall provide necessary testing equipment at the Project site and perform a certified test on ground protection system in presence of the Project Inspector. The ground fault setting shall be selected to coordinate with downstream circuit protective devices. Verify that the system neutral is grounded at the service entrance switchboard only, except neutrals of step-down distribution transformers. For branch circuit protective devices, rated 800 amps or more, provide ground fault protection where shown on the drawings, or as described above, for main protective device. Coordinate settings with main protective device ground fault protection.

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16. In main and distribution switchboards provide a multifunctional digital meter with true RMS measured Amperes (each phase and neutral) Volts (line-to-line and line-to-neutral), Power Factor, Frequency, VA, VAR, Watts, KWH, KVARH, KVAH, voltage/current unbalance, and demand metering: W, VAR, Amperes, VA. Meter to have a front mounted RS232 port to allow programming and meter values via laptop computer and supplied software. The meter shall be GE Multiline PQM with BACnet translator capabilities; equal or better meters will be acceptable with District's approval only. Contractor shall supply the metering software and electronic key to owner.
17. Connections to bussing shall be securely bolted together with corrosion-resistant plated carbon steel, minimum grade five machine screws secured with constant pressure-type locking devices.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Switchboards shall be located so that they are readily accessible and not exposed to physical damage.
- D. Switchboard locations shall provide sufficient working space around the switchboard to comply with the California Electrical Code.
- E. Switchboards shall be securely fastened to the mounting surface.
- F. Switchboard cabinets shall be grounded as specified in Article 250 of the California Electrical Code.
- G. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
- H. Lugs shall be suitable and as required for installation with the conductor being connected.
- I. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- J. Maintain the required bending radius of conductors inside the cabinet.
- K. Distribute and arrange conductors neatly in the wiring gutters.

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- L. Tightening the wire lugs or conductor connections shall be performed in the presence of the Project Inspector. Torque values shall be those recommended by manufacturer.
- M. Remove shipping blocks from component devices.
- N. Manually exercise circuit breakers to verify they operate freely.
- O. Remove debris from switchboard interior.
- P. Follow manufacturer's instructions for installation.
- Q. Furnish one spare fuse for each fusible switch installed. Spare fuses shall be of the same type and rated as those installed.
- R. Do not install in highly corrosive environments such as pool equipment, boiler, chemical and corrosive materials storage rooms, and similar areas. When equipment is installed in such areas, it shall be labeled and listed for the application.
- S. Switchboard equipment and system components shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of bolted electrical connections, and perform insulation resistance tests on each bus section, phase-to-phase and phase-to-ground for one minute in accordance with requirements stated in NETA-ATS 2007 table 100.1. Test shall be performed in the following manner:
 - 1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of bussing, circuit breakers and/or fused switches. The fused switches shall be equipped with fuses or temporary jumpers in place of fuses. Breaker and fused switches shall be tested in the closed position. No wiring shall be connected to the line or load side of the switchgear during testing.
 - a. Provide calibration program records to assure the testing instruments to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).
 - b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.
 - c. Test reports shall include the following:
 - 1) Identification of the testing organization.

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- 2) Equipment identification.
 - 3) Ambient conditions.
 - 4) Identification of the testing technician.
 - 5) Summary of project.
 - 6) Description of equipment being tested.
 - 7) Description of tests.
 - 8) Test results.
 - 9) Analysis, interpretation and recommendations.
1. Perform tests in the presence of the Project Inspector.
 2. During testing, provisions shall be made to prevent damage to solid state components, or electronic equipment such as TVSS equipment that may be tied onto switchboard bussing.
 3. Test results shall meet manufacturer's recommendations or NETA ATS-2007 recommendations, whichever is more stringent.

3.02 PADS AND ANCHORING

- A. Where free-standing equipment is installed at exterior locations or in locations below grade, concrete pads shall be provided as specified in Section 03 3000: Cast-In-Place Concrete.
- B. Where a utility meter is installed in a switchboard, concrete pad shall extend three feet from face of switchboard door or board, whichever is greater. Concrete pad installation shall comply with electric utility company requirements.
- C. Anchor bolts for freestanding equipment shall meet CBC Seismic design requirements, and manufacturer's installation recommendations. The more stringent requirements will be enforced.
- D. Project Record Documents: Provide project record drawings of switchboards as installed, indicating main and branch circuit ratings, circuit numbers and part numbers.
- E. For ground fault relays and sensors, the following information shall be provided:
 1. Certified Calibration and Acceptance Test.

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2. Installation Instructions.
 3. Operating Instructions.
 4. Maintenance Instructions.
 5. Replacement Parts List.
 6. Final Test Report.
- F. Test information shall be submitted to the Architect. Nameplates may be fabricated of engraved laminated plastic or etched metal and shall be permanently attached with escutcheon pins or screws.

3.03 PROTECTION

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

3.04 CLEANUP

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

END OF SECTION

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SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Lighting and power distribution facilities, including panelboards.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 05 00: Common Work Results for Electrical.
 - 3. Section 26 05 13: Basic Electrical Materials and Methods.
 - 4. Section 26 26 00: Power Distribution Units.
 - 5. Section 26 50 00: Lighting.
 - 6. Division 27: Communications.
 - 7. Division 28: Electronic Safety and Security.

1.02 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Shop Drawings: Include a front elevation indicating cabinet dimensions, make, location and capacity of equipment, size of gutters, type of mounting, finish, and catalog number of locks. General layout of internal devices, wiring drawings with wire numbers and device connections, vendor cut sheets of devices in enclosure and bill of materials listing description, manufacturer, part number, and quantity of items shall be included.
- C. Installation Instructions: Submit manufacturer's written installation instructions.

1.03 DESIGN REQUIREMENTS

- A. Panelboards:
 - 1. Panelboards shall be wall-mounted, enclosed safety type with 120/240 volt, three-wire solid neutral 277/480 volt, four-wire or 120/208 volt, four-wire solid neutral mains as indicated on Drawings or specified. First panelboard of each building shall be provided with main or sub-feeder circuit breakers where so indicated.

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2. Single pole branches shall be molded case, thermal magnetic circuit breakers with inverse time delay, trip free, quick-make, quick-break mechanism and silver alloy contacts. Circuit breakers shall be fully rated, with ampere rating marked on handle and shall indicate on/off and tripped positions. Ground fault interrupters shall be incorporated into circuit breakers where indicated. They shall be listed by UL, or other NRTL as ground fault devices. Provide appropriate lug kit of sufficient size to accommodate the feeders.
3. Two- and three-pole branches shall be enclosed and shall be thermal magnetic circuit breakers with inverse time delay, tamper-proof, ambient compensated, single handle, internal common trip, and quick-make, quick-break mechanism with silver alloy contacts. Circuit breakers shall be fully rated or as otherwise indicated on the Drawings.
4. Main and subfeeder circuit breakers shall be enclosed, thermal magnetic type with inverse time delay, single handle common trip, quick-make, quick-break mechanism, corrosion-resistant bearings and silver alloy contacts. Ampere frame size and trip rating shall be as indicated on Drawings. Breakers over 225 amperes shall be furnished with interchangeable trip units. Handles of main and subfeeder circuit breakers shall be provided cabinet door. Voltage rating shall be as indicated on Drawings.
5. Circuit breakers shall be fully rated and of one-piece, bolt-on type and shall meet short-circuit interrupting capacity requirements indicated on Drawings. Series rated circuit breaker combinations are not acceptable.
6. Internal connections shall be fabricated with plated copper bus bars and the busses shall extend for full length of space available for branch circuit breakers. Feeder cable connectors shall be installed at point of feeder entrance. Terminals shall be furnished with copper conductors. Panelboards fed by conductors having over-current protection greater than 200 amperes shall be protected on supply side by over-current devices having a rating not greater than that of panelboards. Copper bussing shall be fully rated. Heat rated bussing is not acceptable.
7. Except where otherwise indicated, circuit breakers shall be in two vertical rows connected to bus bars in a distributed phase arrangement. Two-pole branches shall be balanced on busses. Single pole branches shall be numbered adjacent to its circuit breaker, with odd numbers on left and even numbers on right.
8. Specified circuit breaker spaces shall be furnished with hardware required for future installation of circuit breakers.
9. Provide locking devices for individual circuit breakers. Padlocking devices shall be secured to circuit breakers and by panel dead front plates.

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- B. Surge Suppressors: Where indicated on Drawings, provide transient voltage surge suppressors as an integral part of panelboards. Panelboards shall be complete with 200 percent rated copper neutral bus, ground bus and isolated ground bus in addition to requirements of this section. Surge suppressors shall be as follows:
1. Surge Capacity:
 - a. Line-to-neutral for wye systems: 80 KA.
 - b. Line-to-ground: 80 KA.
 - c. Neutral-to-ground: 80 KA, three-phase wye.
 - d. Line-to-neutral plus line-to-ground: 160 KA.
 2. UL 1449 2nd Edition Suppressed Voltage Rating for 208/120 Wye System:
 - a. Line-to-neutral: 400 volts.
 - b. Line-to-ground: 400 volts.
 - c. Neutral-to-ground: 400 volts.
 - d. Maximum continuous over-voltage: 150 volts.
 3. EMI/RFI High-Frequency Noise Power Filter (Characteristics):
 - a. 100 KHz at 44 dB.
 - b. 100 MHz at 44 dB.
 - c. 10 MHz at 44 dB.
 - d. 100 MHz at 44 dB.
 4. Metal Oxide Varistor (MOV) shall be thermally protected for low current faults and shall be fused with surge-rated fuses. The surge-rated surge current passes and clears the circuit safely if the surge capacity is exceeded. Enhanced diagnostics shall continuously monitor the unit's status and shall include LEDs to signal a reduction in surge capacity or the loss of a suppression circuit. An audible alarm, with test and silence features, shall be furnished in diagnostic package.
 5. Each phase or the entire unit shall be replaceable and have bolted-on, tin-plated copper connections. Unit to have UL witnessed fault current rating of 65,000 symmetrical amperes.

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6. Surge suppression units shall comply with the following:
 - a. UL certified.
 - b. UL 1283.
 - c. UL 1449.
 - d. IEEE C 62.45.
 - e. IEEE C 62.41.
 - f. Nationally Recognized Testing Laboratory (NRTL) or equal.

C. Panelboard Cabinets:

1. Panelboard cabinets shall be code gage galvanized steel or blue steel; fronts, doors, and trims shall be code gage furniture steel. Cabinets shall be furnished with at least six-inch high gutters at top and bottom where feeder cable size exceeds four gage or where feeder cable passes through cabinet vertically. Cabinets shall be furnished with top and bottom gutters sized as required by inspection department having jurisdiction, but never less than six inches where more than one feeder enters top or bottom of cabinets. Side gutters shall not be less than four inches wide. Width of cabinets shall be 20 inches, unless otherwise indicated on Drawings.
2. Doors shall be cut true, shall accurately fit opening and finish smooth across joints. Rabbets shall be inside. Hinges shall be entirely concealed except for barrels and pins. Hinge flanges shall be welded to door and trim. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors, keyed to Corbin No. 60 keys.
3. Where contactors, time switches, and control devices are specified or indicated to be installed within panelboard cabinets, a separate compartment and door shall be provided at top of cabinet for such devices. Door shall be sized as required to permit removal of contactor and other devices intact. Gutters shall be provided at sides and top of compartment. Doors shall be equipped with flush type, spring-latching, Corbin locks for metal doors keyed to Corbin No. 60 keys.
4. Provide and install panelboard manufacturer's permanent circuit number kit option.
5. Panelboards with control devices in compartment shall arrive at the Project site completely assembled with control devices installed and wired.

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6. Outdoor cabinets shall be NEMA Type 3R. Construction shall be formed from code gage galvanized steel with ANSI No. 61 gray enamel finish. Provide heavy-duty, three point latching, vault type door handles with padlocking provisions. Provide stainless steel or galvanized butt hinges on doors. Padlocks shall be furnished, keyed to Corbin No. 60 keys.
 7. Self-tapping screws and bolts not permitted.
- D. Panelboard Schedule: Provide a neatly typewritten schedule with number or name of room or area, or load served by each panelboard circuit. Room numbers or names shall be determined at the Project site and shall not necessarily be those indicated on the Drawings. Schedule shall also indicate panel designation, voltage and phase, building and distribution panel or switchboard from which it is fed. Schedule shall be installed in a frame under transparent plastic 1/32 inch thick on inside of each panelboard cabinet door.
- E. Panelboard nameplate: Provide a nameplate identifying panelboard. Plates shall be black and white plastic nameplate stock, with character cut through black exposing white and shall bare designation of service. Name plate shall be mechanically fastened to switchboard.
- F. Provide additional labeling on dead-front of panelboard. Label shall be a P-Touch or equal with a minimum width of 3/8 inch with black letters on white background. Label shall re-identify panelboard and also identify name and location of power source feeding this panel. Location information shall include building name if located in different building and name or room location. If power source is installed in same room, label should indicate source name and "In this Room"
- G. Panelboard Standards: Panelboards shall be UL, or other NRTL listed and labeled. Panelboards shall meet latest revisions of following standards:
1. California Electric Code, Article 384.
 2. UL 67, Panelboards.
 3. UL 50, Cabinets and Boxes.
 4. UL 943, GFCI.
 5. UL 489, Molded Case Circuit Breakers.
 6. NEMA PB1.
 7. Federal Specifications W-P- 115C and WC-375B.
- H. Signal Terminal Cabinets:

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1. Signal terminal cabinets shall conform to the Specifications for panelboard cabinets, except as modified herein.
2. Terminal cabinets shall be flush type, with two-inch trim or surface mounted type, as indicated on Drawings. Terminal cabinets shall be furnished with sections and barriers to separate each system. Sections over 24 inches in width shall be provided with double doors and locks. Terminal cabinets, or sections of terminals housing separate systems, shall measure 12 inches long by 18 inches high by 5 ¾-inch deep, unless otherwise indicated on Drawings. Trims for sectional cabinets shall be of one-piece construction.
3. Terminal cabinets shall be furnished with ¾ inch thick plywood. Plywood shall be fastened in place with machine screws or factory installed mounting screws.
4. Flush-mounted terminal cabinets shall be finished as specified for flush-mounted panelboard cabinets. Surface and semi-flush mounted terminal cabinets shall be finished as specified for surface-mounted panelboard cabinets.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Panelboards shall be manufactured by Siemens, W.A. Benjamin, General Electric, Cutler Hammer, Square D or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Panelboards shall be located so they are readily accessible and not exposed to physical damage.
- B. Panelboards installed outdoors shall be specifically listed for wet locations and shall be weatherproof in NEMA Type 3R cabinets.
- C. Panelboard locations shall provide sufficient working space around panels to comply with the California Electrical Code.
- D. Panelboards shall be securely fastened to structure and mounted on surface by at least four points.

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- E. Unused openings in cabinets shall be effectively closed as required by the manufacturer.
- F. Cabinets shall be grounded as specified in Article 250 of the California Electrical Code.
- G. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the enclosure.
- H. Lugs shall be suitable and listed for installation with the conductor being connected.
- I. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- J. Maintain the required bending radius of conductors inside the cabinet.
- K. Clean the cabinet of foreign material such as cement, plaster, and paint.
- L. Distribute and arrange conductors neatly in the wiring gutters.
- M. Use the manufacturer's torque values to tighten lugs.
- N. Before energizing panelboards, the following steps shall be taken:
 - 1. Retighten connections to the manufacturer's torque specifications. Verify that required connections have been provided.
 - 2. Remove shipping blocks from component devices and panelboard interiors.
 - 3. Manually exercise circuit breakers to verify they operate freely.
 - 4. Remove debris from panelboard interior.
- O. Follow manufacturer's instructions for installation.
- P. Do not install in highly corrosive environments, unless rated for the application.

3.02 PROTECTION

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

3.03 CLEANUP

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

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END OF SECTION

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SECTION 26 24 19 - MOTOR CONTROL CENTER AND MOTOR CONTROL DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Disconnect switches and motor starters for motors or equipment and connections to the motors.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Division 23: Heating, Ventilating, and Air Conditioning "HVAC".
 - 3. Section 26 05 00: Common Work Results for Electrical.
 - 4. Section 26 05 13: Basic Electric Materials and Methods.
 - 5. Section 26 05 26: Grounding and Bonding.
 - 6. Section 26 24 13: Switchboards.

1.02 SUBMITTALS

- A. Shop Drawings: Include a front elevation, indicating dimensions, make, location and capacity of equipment, type of wiring, size of gutters, type of mounting, size of anchoring bolts and finish. Installation shall be in compliance with CBC seismic design requirements.
- B. Product Data: Submit catalogs indicating make, ratings, dimensions, and catalog number for disconnect switches, motor starters, and control devices.

1.03 DESIGN REQUIREMENTS

- A. Motor overload protection of manual reset type, as part of a motor starter and set at not to exceed 125 percent of motor full load current rating, shall be provided for each motor exceeding 1/8 horsepower in size except where indicated otherwise and except for following: Motors of sufficient impedance to prevent overheating on failure to start (such as clock motors), and motors provided with an approved built-in manual reset type device, responsive to motor current and set at not to exceed 125 percent of the motor full load current rating, which will interrupt current to motor.

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- B. Switchboard components shall be provided with nameplates. Plates shall be black and white plastic stock, with characters cut thorough black exposing white, and shall bear designation of service, feeders controlled, and fuse sizes.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Motor Control Centers:

1. Motor control centers shall be of metal-clad, free floor-standing dead-front type, totally enclosed with one or more vertical sections. Arrangement and construction shall be as indicated on Drawings and as specified. Design, construction, and testing shall comply with requirements of latest CEC, UL publication UL-845, NEMA publication ICS 2.3 and applicable standards of ASA, AIEE, and NEMA. Equipment shall be completely fabricated, wired and tested at factory, and shall be shipped in sections ready for installation, complete with required assembly bolts and mounting channels. General construction shall consist of modular vertical sectioned cubicles, approximately 90 inches high and 20 inches wide. Sectional cubicles shall be bolted together to form required arrangement having the appearance of a single assembly. Cubicle sections shall be fabricated from a minimum of 12 gage P & O Mill prime sheet steel, shaped, reinforced, and welded to form a rigid structure. Sections shall contain required number of modular spaces for various starter units. Wiring gutters shall extend through cubicles with front accessible bolted filler plate covers. Connections shall be securely bolted together with corrosion-resistant plated carbon steel, of minimum grade five machine screws, secured with constant pressure type locking devices. Self-tapping screws will not be permitted.
2. Bus bars and connections shall be copper. Vertical buses shall be rated at not less than 300 amperes and shall be placed to allow starter units to be connected by pushing into place. Bus connections shall be free fitting and bolted, with silver plated connecting areas rated at 200 amperes per square inch. Bus work bracing and support shall withstand the short circuit stresses indicated on Drawings without damage to buses or structure. Connections shall be secured bolted together with corrosion-resistant plated carbon steel, of minimum grade five machine screws, secured with constant pressure type locking devices. Self-tapping screws will not be permitted
3. Main horizontal and vertical buses shall be made of copper and entire length shall be electrolytically silver-plated. Copper ground lugs shall be provided in incoming line vertical sections. Horizontal tin-plated copper ground buses shall be provided in each section of the motor control center. Horizontal ground bus shall run continuously throughout control center, drilled and

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tapped every ten inches for ¼ - 20 machine screws. RMS amperes symmetrical bus bracing shall be as indicated on Drawings. Vertical sections shall support horizontal and vertical buses, combination started units, covers and doors. Vertical sections shall be furnished with structural supporting members formed of a minimum of 13 gage hot-rolled steel. Reinforcement for structural parts shall be of ten gage steel to provide a strong, rigid assembly. Vertical sections shall be designed to accommodate bolts on units 20 inches wide and 20 inches deep, and shall be provided with 12 inches high horizontal wireway located at bottom of sections and a six-inch horizontal wireway at top of sections in addition to the vertical wireways for each section. Busing components shall be secured bolted together with corrosion-resistant plated carbon steel, of minimum grade five machine screws, secured with constant pressure type locking devices. Self-tapping screws will not be permitted

4. Separate control cell compartments of sizes indicated on Drawings shall be provided for future interlocking relays and transducers.
5. Starters shall be of the bolt-on combination magnetic type, as indicated on Drawings, each with a separate hinged door. Starters shall be provided with separate overloads in each phase.
 - a. Combination magnetic starters shall be circuit breaker magnetic across-the-line type, or as indicated on Drawings, and shall be furnished with suitable thermal overload elements for controlled motor. Breaker shall be bussed with copper bus bars. Covers shall be mechanically interlocked with circuit breakers to prevent opening when energized. Circuit breaker handles shall be capable of being padlocked in the off position with one to three padlocks.
 - b. Each motor starter shall be furnished with a red pilot light, HOA selector switch or pushbutton station, and a control circuit transformer, unless otherwise indicated on Drawings. Control circuit transformer shall be fused.
6. Units shall be provided with unit doors, unit support pans, unit saddles, and unit disconnect operators. Units shall be designed and constructed so that faults will be localized within compartment.
7. Control devices and wiring of motor control centers shall be in accordance with functional wiring diagrams indicated on Drawings and requirements of controlled equipment.
8. Motor control center wiring shall be NEMA Class 1, Type B.
9. Motor control center shall be as manufactured by Cutler Hammer, W.A. Benjamin Electric, Square D, General Electric, or equal.

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B. Disconnect Switches:

1. Heavy duty type switches shall be 240 volt or 480 volt as required, totally enclosed, externally operated, with quick-make, quick-break operating mechanism, interlock cover, and provisions for locking cover in closed position and locking switch in on and off positions. Switches shall be single-throw, unless otherwise indicated or specified. Switches controlling direct current loads shall be DC rated.
2. Switches shall be furnished with switch blades, which are fully visible in off position when switch door is open. Current carrying parts shall be plated to resist corrosion and promote cool operation. Switches shall be furnished with removable arch suppressors where necessary to permit easy access to line side lugs. Lugs shall be front removable and UL, or other Nationally Recognized Testing Lab listed for 75 degrees C. copper wires.
3. Switch enclosure shall be NEMA Type 1 for indoor locations and rain-tight, NEMA Type 3R, rainproof for outdoor locations. NEMA Type 3R enclosures shall be manufactured from galvanized steel with gray baked enamel and shall be furnished complete with rainproof bolt on hubs. Covers shall be attached with pin type hinges. Removable closing cap types are not permitted. In kitchen area, provide disconnect switchers in a NEMA type 4 stainless steel enclosure. Quick release latches shall be permitted only when furnished tamper-resistant to prevent breakage due to vandalism, and furnished with Corbin 66 locks keyed to Corbin 60 key. Switches shall be fusible or non-fusible as indicated on Drawings. Fusible switches shall accept cartridge fuses. Current rating of switches, number of poles, solid neutral facilities, and current rating of fuses shall be as indicated on Drawings. Switches shall have proper horsepower rating equal to or greater than horsepower of motor controlled. Only lower horsepower rating of dual rated switches will be permitted as a switch rating. Switches shall accept Class H, Class J and Class R fuses.
4. Padlocking device shall lock operating handle and cover with one padlock regardless of on or off position. Switches shall be heavy duty type, as manufactured by Square D, General Electric, Cutler Hammer or equal. Furnish a minimum of two padlocks and two keys with each switch. Padlocks shall be Corbin No. 66 keyed to Corbin No. 60 keys.
5. Switches shall be UL listed and shall comply with NEMA Standard KS-1.
6. Furnish one spare fuse for each fusible disconnect switch installed. Spare fuses shall be same type and rating as those installed.

C. Motor Starters:

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1. Motor starters shall be AC magnetic across-line starters unless otherwise indicated on Drawings.
2. AC magnetic across-the-line starters shall be furnished with manual reset thermal overload protective devices including heating elements. Starters shall be furnished in a NEMA Type 1, NEMA Type 3R or other type of enclosure as indicated on Drawings. Starters shall be furnished with HOA selector switches or push-buttons, as indicated on Drawings. NEMA size, voltage rating, number of poles, and special features shall be as indicated on Drawings. Horsepower rating of each starter shall be equal to or greater than motor horsepower. Starters for motor circuits rated at 208 volts and above shall be provided with a control circuit transformer, having a 120 volt secondary. Combination magnetic starters are permitted. Three-phase starters shall be furnished with three-element protection.
3. Manual across-line starters shall be furnished with manual reset thermal overload protective devices, including heating elements, start-stop-reset device or H.O.A. switch as indicated on Drawings, operable from front. Enclosure shall be NEMA Type 1 for indoor installation and NEMA Type 3R for outdoor installation or as indicated on the Drawings. NEMA size, voltage rating and number of poles shall be determined by motor horsepower, voltage and phase indicated on Drawings. Horsepower rating of each starter shall be equal to or greater than motor horsepower. Combination manual starters are permitted.
4. Thermal switch starters shall be tumbler type with plaster ears, binding screws for wiring, standard size composition cups which fully enclose mechanism, and shall be designed to fit standard outlet boxes. Thermal switches shall be fractional horsepower motor starters with thermal overload protective devices including heating elements and with handle providing on-off-reset control. Horsepower rating, voltage rating, and number of poles shall be determined from motor horsepower and voltage indicated on Drawings. Switches shall be key operated where so indicated on Drawings. Furnish one key with each key type switch. Horsepower rating of each switch shall be equal to or greater than motor horsepower.
5. Relays furnished for directly controlling motors shall be installed in NEMA Type 1 enclosure for indoor installations and NEMA Type 3R for outdoor installations, unless otherwise indicated or specified and shall be horsepower rated. Relay size, voltage rating and number of poles shall be determined from motor horsepower and voltage indicated on Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

Budlong

3361-008-000

MOTOR CONTROL CENTER AND MOTOR CONTROL DEVICE

26 24 19-5

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- A. Motor control centers installed outdoors, or below grade, shall be installed on a concrete pad as specified in Section 03 3000: Cast-In-Place Concrete, and as indicated on Drawings.
- B. Anchor bolts for freestanding equipment shall be designed to meet CBC seismic requirements. Equipment shall be anchored to concrete slab with anchor bolts. Provide structural drawings for Architect review prior to start of construction.
- C. Equipment shall be located so that it is readily accessible and not exposed to physical damage.
- D. Equipment locations shall provide sufficient working space around the equipment to comply with the California Electrical Code.
- E. Equipment installed outdoors shall be specifically approved for wet locations and shall be installed in a weatherproof NEMA Type 3R enclosure.
- F. Equipment shall be securely fastened to the mounting surface.
- G. Equipment enclosure shall be grounded to comply with Article 250 of the California Electrical Code.
- H. Conduits shall be installed so as to prevent moisture or water from entering and accumulating within the equipment enclosure.
- I. Lugs shall be suitable and permitted for installation with the conductor being connected.
- J. Conductor lengths shall be maintained to a minimum within the wiring space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- K. Maintain the required bending radius of conductors inside the cabinet.
- L. Distribute and arrange conductors neatly within the equipment space.
- M. Tightening of wire lugs or any conductor connections shall be performed in the presence of the Project Inspector. Torque values shall be those recommended by manufacturer.
- N. Remove shipment blocks from component devices.
- O. Manually exercise switches and circuit breakers to verify they operate freely.
- P. Remove debris from equipment interior.

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- Q. Follow manufacturer's instructions for installation.
- R. Furnish one spare fuse for each fusible switch installed. Spare fuses shall be of the same type and rating as those installed.
- S. Record Drawings: Submit project record drawings indicating the motor control center exactly as it was installed, including wiring diagrams of components.
- T. Installation Instructions: Submit manufacturer's written installation instructions, including recommendations for handling, protection and storage.
- U. Installation in corrosive environments such as boiler rooms, pool equipment, and other similar spaces is not allowed.
- V. Motor Control Center equipment and system components shall be free from short circuits and grounds, other than required grounds. The contractor shall be responsible for the testing of bolted electrical connections, perform insulation resistance tests on each bus section, phase-to-phase and phase-to-ground for one minute in accordance with requirements stated in NETA-ATS 2007 table 100.1. Test shall be performed in the following manner:
 - 1. Utilize the services of an approved independent testing laboratory to perform megger time-resistance insulation testing of bussing, circuit breakers and/or fused switches. The fused switches shall be equipped with fuses or temporary jumpers in place of fuses. Breaker and fused switches shall be tested in the closed position. No wiring shall be connected to the line or load side of the motor control center during testing.
 - a. Provide calibration program records to assure the testing instruments to be within rated accuracy. The test equipment accuracy shall be in accord with the requirements stated by the National Institute of Standards and Technology (NIST).
 - b. Test equipment shall be provided with a label stating the date of last calibration. As a minimum the equipment shall have been calibrated within the past 12 months.
 - c. Test reports shall include the following:
 - 1) Identification of the testing organization.
 - 2) Equipment identification.
 - 3) Ambient conditions.
 - 4) Identification of the testing technician.

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- 5) Summary of project.
 - 6) Description of equipment being tested.
 - 7) Description of tests.
 - 8) Test results.
 - 9) Analysis, interpretation and recommendations.
2. Perform test in the presence of the Project Inspector.
 3. During testing, provisions shall be made to prevent damage to any solid state components, or electronic equipment such as TVSS equipment that may be tied onto panel bussing.
 4. Test results shall meet manufacturer's recommendations or NETA ATS- 2007 recommendations, whichever is more stringent.
- 3.02 PROTECTION
- A. Protect the Work of this section until Substantial Completion.
- 3.03 CLEANUP
- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

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SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Lighting fixtures, including lamps, wiring, and lighting controls.
- B. Light fixtures model numbers were determined at the time this specification was written; model numbers may need to be modified, or may require the addition or deletion of options to fully meet specification requirements.
- C. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 05 00: Common Work Results for Electrical.
 - 3. Section 26 05 13: Basic Electrical Materials and Methods.
 - 4. Section 26 05 26: Grounding and Bonding.
 - 5. Section 26 05 19: Low-Voltage Wires (600 Volt AC or less).
 - 6. Section 26 09 23: Lighting Controls Systems.
 - 7. Section 32 1313 - Site Concrete Work.

1.02 SUBMITTALS

- A. List of Materials: Submit a complete list of materials proposed for this section.
- B. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of sockets, size of lamps, and complete details of method of fitting suspension and fastening fixtures in place. Provide wiring diagrams for lighting control equipment. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.
- C. Prior to start of construction; provide photometric calculations with graphic of luminance levels of work plane, ceiling and walls of each rooms. Calculations shall comply with IESNA recommendations.
- D. Installation Instructions: Submit manufacturer's written installation instructions for fixtures and accessories.

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- E. Light fixtures shall be Underwriters Laboratory (UL) or Nationally Recognized Testing Laboratory (NRTL) listed, and in compliance with applicable industry standards and codes.
- F. Submittals must comply with contract general provisions.

1.03 MOUNTING REQUIREMENTS

- A. Design of lighting fixtures, accessories, supports, and method of fixture installation shall comply with requirements for earthquake-resistant construction of the State of California.
- B. Provide suspension points at no more than two feet from fixture ends. Spacing between supports shall not exceed eight feet.

1.04 QUALITY ASSURANCE

- A. Components and fixtures shall be listed and approved for the intended application by Underwriter's Laboratories (UL), or other Nationally Recognized Testing Laboratory (NRTL).
- B. OWNER's written approval shall be obtained for any equipment or materials substitutions prior to their use.

1.05 GUARANTEE

- A. Provide a two year labor warranty.
- B. Provide material warranty as specified:
 - 1. Lamps: two years.
 - 2. Standards: one year.
 - 3. Controls: three years.
- C. Warranty period begins at substantial completion or project acceptance for beneficial occupancy.

PART 2 - PRODUCTS

2.01 MATERIAL AND FABRICATION

- A. Lighting fixtures shall be the type indicated on Drawings and as specified. Fixtures of same type shall be of one manufacturer.

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- B. Fixtures shall be of the types and manufacturers described in the LIGHTING FIXTURE SCHEDULE provided in the Electrical drawings, with lamps, wattage and voltage as indicated. Specific manufacturer and model number references are indicated as a standard of performance and quality; other manufacturers' models may be supplied provided the product meets or exceeds the specifications. The alternate fixtures shall achieve the same photometric levels and uniformity ratios.
- C. Fixtures shall be baked-on enamel or powder-coated, unless otherwise specified in subsections below.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install a lighting fixture for each lighting outlet indicated and mark with day of installation.
- B. Fixture voltage shall be as indicated on Drawings.
- C. Install recessed and surface-mounted fixtures, with plaster frames compatible with ceiling and wall systems employed; secure fixtures mechanically to frames.
- D. Align rows of suspended and surface-mounted LED fixtures to form straight lines at uniform elevations.
- E. Recessed fixtures shall fit snugly against ceilings to prevent light leakage.
- F. Notwithstanding the following paragraphs in Part 3-Execution, fixture installations shall comply with the most current CBSC and Department of State Architect Seismic requirements.
- G. Support suspended recessed fixtures in accordance with DSA IR 25-2.10. Support pendant-mounted fixtures in accordance with DSA IR 16-9. Fixture installations shall be coordinated with acoustical and gypsum ceiling installation.
- H. Emergency light fixtures shall be labeled "Emergency Fixture" with one inch high letters produced with a P-touch or similar labeling system and shall be put on the housing.
- I. Continuous suspended fixtures:
 - 1. Fixture suspension device shall allow vertical adjustment of fixture without the use of tools. Cable shall be minimum seven strand twisted stainless steel capable of supporting minimum four times the fixture weight. For continuous

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linear suspended fixtures longer than eight feet, provide not less than three suspension points.

2. Top of fixture shall be suspended as shown on the Drawings.
 3. Fixture shall utilize factory furnished or approved hardware and canopy for either hard or T-bar ceilings.
- J. Where fixtures with emergency battery packs are installed, these fixtures shall receive constant powered circuits. When powering unit inverter power packs, use the same circuit that powers the switched ballast to power the inverter.
- K. Surface mount fixtures shall be attached to structure. Toggle bolts shall NOT be used or permitted. Provide backing supported by structure where required.

3.02 TESTING

- A. Check and adjust fixtures for required illumination.
- B. Test and adjust lighting control equipment for proper operation.

3.03 SPARE PARTS

Provide the following spare parts:

- a. Furnish 5% spare lamps with a minimum of one spare lamp of each type.
- b. Furnish 5% spare motion detectors of each type with a minimum of one spare detector of each type.

3.04 HAZARDOUS WASTE DISPOSAL

- A. Hazardous waste disposals and recycling shall be handled and disposed of by an approved, licensed CONTRACTOR.
- B. Store, remove, transport and dispose of hazardous materials in all accordance with state and federal regulations.
- C. Provide OWNER with copy of manifest and certificate of destruction and/or recycling no later than achievement of substantial completion.

3.05 PROTECTION

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

3.06 CLEANUP

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- A. Remove rubbish, debris, and waste materials from all areas of work each day.
- B. Clean fixture surfaces of dirt, cement, plaster and debris. Furnish cleansers compatible with material surfaces being cleaned.

END OF SECTION

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27 51 17- CONVERGED IP PUBLIC ADDRESS AND INTERCOMMUNICATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Installation of all components, and configuration necessary for the complete installation and functionality of a fully tested and operational IP Converged public address and intercommunication system.
- B. The system shall include all call paging access from the VoIP Telephone system, access to individual speaker, zone paging, all calls, other rooms, etc. System shall also provide for interfacing with the clock system for a class change signaling system and Fire Alarm system with override of PA tone signaling capability. The clock system shall include IP based NTP or master clock.

1.02 RELATED SECTIONS

- A. Applicable Division 1 sections
- B. Section 00 70 00: General Conditions
- C. Section 01 77 00: Contract Closeout
- D. Section 21 23 23: Excavating, Backfilling and Compacting for Utilities
- E. Section 06 10 00: Rough Carpentry
- F. Section 26 05 00: Common Works Results for Electrical
- G. Section 26 05 13: Basic Electrical Materials and Methods.
- H. Section 26 05 26: Grounding and Bonding
- I. Section 26 05 33: Raceways and Boxes Fittings and Supports.
- J. Section 26 24 16: Panelboards and Signal Terminal Cabinets
- K. Section 27 01 26: Test and Acceptance Requirements for Structured Cabling
- L. Section 27 05 36: Cable Trays for Communications
- M. Section 27 10 14: Structured Cabling - new construction
- N. Section 27 10 15: Premises Wiring for Convergence of Communication Systems

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O. Section 27 51 29: Autonomous PA Sound System

P. Section 28 31 00: Fire Detection Alarm

1.03 REFERENCES

A. Electronics Industries Alliance (EIA):

1. EIA 160 Sound Systems
2. EIA-101 Amplifiers for Sound Equipment
3. EIA/TIA-568: Commercial building telecommunications wiring standard.
4. EIA/TIA-569: Commercial building standard for telecommunications pathways and spaces.
5. EIA/TIA-606: Administration standard for telecommunications infrastructure of commercial buildings.
6. EIA/TIA-607: Commercial building grounding and bonding requirements for telecommunications.
7. IEEE 802.3af or 802.3at: Standard for Internet

B. California Electrical and Fire Codes.

C. Building Industry Consultant Service International (BICSI):

1. Telecommunications Distribution Methods Manual

D. Federal Trade Commission (FTC):

1. Green Guides, 16 CFR Part 260, Guides for the Use of Environmental Marketing Claims.

E. Underwriters Laboratory listings and other labels

1. ANSI, ASTM, UL, NEMA, IEEE and FCC standards as applicable.
2. ANSI/UL 2900-2-1, Standard for Software Cybersecurity for Network-Connectable Products.

1.04 SUBMITTALS

A. Provide the following submittals in accordance with Division 01:

1. Materials list: Submit a complete material list for the materials and products of this section.

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2. Product Data: Include Product Data sheets and/or catalog cut sheets for all items to be installed. Data shall be clearly marked and noted to identify specific ranges, model numbers, sizes, and other pertinent data. Items shall be arranged in the same order as the index and if more than one item is indicated, the submitted items shall be highlighted or marked with an arrow. Product Data shall be sufficiently detailed to allow the ARCHITECT to review the product and to allow other trades to provide necessary coordination.
 3. CONTRACTOR shall include in the Product Data list submission, copies of manufacturer certificates that the CONTRACTOR is an authorized distributor of the submitted manufacturer's products; and each member of the installation crew has been trained and certified in the installation of those products. CONTRACTOR shall submit proof that his/her company has a service organization capable of responding within 24 hours of receipt of written notification and resolution within 1 day.
- B. Shop Drawings: CONTRACTOR provided Shop Drawings shall indicate the following:
1. Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of devices and components, and complete details of method of fitting suspension and fastening devices in place. Provide wiring diagrams. Drawings shall contain enough information to assemble and install equipment at the Project site without further instructions.
 2. Provide, drawn to scale, details of racks, consoles and cabinets with designations, elevations, dimensions, doors, barriers, mounting details, catalog number of locks, finishes and color.
 3. Provide a dimensioned detail of console nameplate including school name, address, and power load. Indicate manufacturer's part numbers for all controls, switches, connectors and indicators.
 4. Provide a complete sets of drawings of wiring diagram for each rack, instrument wiring and schematic diagrams of circuits of all equipment.
 5. Provide detailed drawings as to interfaces with equipment furnished by others including number of wires, termination requirements, input/output voltages, input/output signals and other required coordination items, items including point to point connection details for all devices and equipment,
 6. Shop drawings shall indicate equipment locations, wiring and schematics, details, configurations, sizes and a point-to-point wiring diagram of all components. Shop drawings shall indicate interfaces to equipment furnished by others, identifying termination interface requirements, and other specific details.
 7. Provide one set of full-size shop drawings, in the same size as the Record Drawings, and 3 USB flash drive electronic copies.

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8. Shop Drawings shall be prepared in the latest version of Windows compatible AutoCAD.
 9. Installation and coordination drawings for items in other sections shall be included with submittal of Shop Drawings. Submit blue line copies and one reproducible copy of installation and coordination drawings.
- C. Sample Materials: CONTRACTOR shall provide samples of material and equipment as required by the ARCHITECT. If samples are requested, they shall be submitted within 10 days from the date of request.
- D. Sound calculations: Submit calculations of sound distribution and dB levels.
- E. Certified Statements: CONTRACTOR shall provide the following certification statements:
1. CONTRACTOR shall provide a letter from the Manufacturer assuring the availability of spare parts common to proposed system for a period no less than 5 years on all components.
 2. Certification of compliance with the California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act. These materials shall not exceed the following allowed content in parts per million (ppm):
 - a. Lead content > 0.1% or 1000 ppm.
 - b. Mercury Content > 0.1% or 1000 ppm.
 - c. Cadmium Content > 0.01% or 100 ppm.
 - d. Hexavalent Chromium > 0.1% or 1000 ppm.
 - e. Polybrominated Biphenyls > 0.1% or 1000 ppm.
 - f. Polybrominated Biphenyls Ether > 0.1% or 1000 ppm.

1.05 SUBSTITUTIONS

- A. Equipment and materials that deviate from these requirements shall not be accepted without written approval from OWNER'S project manager. When deviating or substituting equipment, the following information shall be submitted:
1. Substitution request form substantiating reasons and benefits to OWNER.
 2. OWNER'S approval shall be obtained for any equipment or materials substitutions. Proposed substitutions requests shall provide proof of compliance with OWNER'S criteria described in this specification.

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3. Submittals must comply with contract general provisions.

1.06 QUALITY ASSURANCE

- A. Work shall conform to CCR, Title 24 Part 3, Basic Electrical Regulation and National Electrical Code, latest edition.
- B. Only a qualified CONTRACTOR holding licenses required by legally constituted authorities having jurisdiction over the work, shall do the work.
- C. Persons skilled in trade represented by work, and in accordance with all applicable building codes, shall install system in accordance with best trade practice.
- D. Work shall be performed by CONTRACTOR that has completed at least 5 college level systems of equal scope to system described herein and shall have been engaged in business of supplying and installing specified type of systems for at least 5 years. CONTRACTOR shall maintain a fully equipped service organization capable of furnishing repair service to equipment.
- E. The CONTRACTOR shall use adequate numbers of skilled workmen who are currently manufacturer certified, thoroughly trained and experienced on the necessary crafts and completely familiar with the specified requirements and methods needed for the proper performance of the work.
- F. The CONTRACTOR shall coordinate cable runs, and rack equipment locations with the OWNER's Authorized Representative during the initial design of the cable installation. CONTRACTOR and OAR must agree as to the final location of all devices and the cable plant design.
- G. The CONTRACTOR shall provide technicians and tools required to participate in OWNER's Quality Assurance Testing as detailed in Attachment "A" of this specification.
 - 1. Items on check list of Attachment "A" will be examined as a minimum at the Public Address Head End, terminal cabinets, ground vaults and classrooms. Should the examination show deficiencies related to items in the checklist, OWNER's acceptance testing will be discontinued until corrections have been made. When the CONTRACTOR has completed the corrections, a subsequent Quality Assurance test shall be initiated. This procedure is in addition to the system functionality testing required in section 3.03 below.

1.07 WARRANTY

- A. CONTRACTOR shall warranty that all work executed and materials furnished shall be free from defects in materials and workmanship for a minimum period of five (5) years from date of installation acceptance, date of Contract Completion, excluding specific items of work that require a warranty of a greater period as set forth in this Specification. In the event a manufacturer's warranty is longer than five (5) years, the manufacturer's warranty shall be the warranty period. Immediately upon receipt of written notice from the OWNER, the CONTRACTOR shall repair or replace at no expense to the OWNER, any defective material or work that may be discovered before final acceptance of work or within warranty period; any material or work damaged thereby; and adjacent material

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or work that may be displaced in repair or replacement. Examination of or failure to examine work by the OWNER shall not relieve CONTRACTOR from these obligations.

- B. All warranty shall provide the District direct access to manufacturer Technical Assistance Center (TAC), software updates, and defect support.
- C. Equipment or materials failure rates of 10% or more during the warranty period:
 - 1. The District shall monitor the performance and reliability of the installed base of Equipment and Materials installed in this Contract. Any deficiencies or malfunctions will be referred to the CONTRACTOR for repairs or equipment replacement.
- D. If the District detects a defect within a warranty period as defined here in, it shall notify the CONTRACTOR Representative in writing ("Notice of Defect"). The CONTRACTOR shall make available and provide the District with the telephone number of a fax machine to receive Notices of Defect. This fax machine shall be available to receive faxes 24 hours per day 7 days per week, including all weekends and holidays
- E. Upon receipt of written notice from the District of any failure or defect ("Defect") in any such Equipment or Work, the CONTRACTOR shall diligently perform all work necessary to determine the cause thereof, and the time necessary to remedy the Defect, and shall propose in writing to the District how and in what manner it will remedy the Defect. If the District determines that the proposal complies with the terms of the Contract, it shall authorize CONTRACTOR to proceed to redesign, repair, or replace the defective or failed Equipment or Work within the agreed time period.
- F. In determining the cause of the Defect, the CONTRACTOR shall perform such investigations and tests as may be required to determine the cause, and to verify that such redesign, repairs, and replacements comply with the requirements of the Contract Document. All cost associated with such investigation, redesign, repair, replacement, and testing, including, but not limited to, the removal, replacement, and reinstallation of equipment and materials necessary to gain access to defective Equipment, shall be borne by the CONTRACTOR. Should the CONTRACTOR fail to promptly make the necessary investigations, redesign, repair, replacement, and test, the District may perform or cause to be performed the same at the CONTRACTOR's expense.
- G. The CONTRACTOR will warrant the redesigned, repaired, or replaced Equipment against defective design, materials, and workmanship for the remainder of the warranty period or a period of to five (5) years from and after the date of acceptance of the redesigned, repaired or replaced Equipment thereof, whichever occurs later.
- H. The CONTRACTOR shall be liable for the satisfaction and full performance of the warranties as set forth herein.
- I. All warranties hereunder are deemed and acknowledged to explicitly extend to the future performance of the Equipment warranted.

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- J. The rights and remedies provided for herein are cumulative and shall not be exclusive and are in addition to any other rights and remedies provided by law, whether in contract or tort, or under this Contract.
- K. CONTRACTOR is deemed and acknowledged to be a merchant with respect to all components and replacement parts furnished pursuant hereto, and the District is acknowledged not to be a merchant with respect thereto.
- L. In the event any Supplier or manufacturer offers any extended warranty not specified herein, CONTRACTOR shall state the terms of such warranty or warranties in writing and shall extend the same to the District without additional cost to the District.
- M. All warranties and guarantees of Suppliers of any tier and Manufacturers, whether expressed or implied, are deemed to be made for the benefit of the District regardless of whether stated as such, and CONTRACTOR shall enforce such warranties and guarantees for the benefit of the District.
- N. CONTRACTOR shall include a letter signed by a corporate officer, partner, or OWNER of the contracting company describing their service organization, its capabilities and commitment to servicing the warranty on all work executed and materials furnished.

1.08 SYSTEM REQUIREMENTS

- A. The system shall be a combined public address and intercommunication system. Furnish, install, configure and connect all necessary sub-components to provide for functions and requirements specified, including interfaces and cabling to VoIP Telephone system, autonomous systems' overrides, the Master Clock system and the Fire Alarm system.
 - 1. Provide all labor, engineering, testing, materials, supervision, tools, mounting hardware, cable management, software and components necessary or required to provide a complete operable installation. The system shall be installed in compliance with project documents, applicable codes, and industry standards to deliver a system that meets standards of quality functionality.
 - 2. Provide services on Project site including specified connectivity for all administration areas, classrooms, computer and science laboratories, libraries, auditoriums, multipurpose rooms, P.E. areas, quad area other instructional areas, and work areas as indicated in Project Drawings.
 - 3. The CONTRACTOR shall provide full configuration services for all CONTRACTOR provided equipment.
- B. Basic Requirements:
 - 1. System shall be packet audio technology IP network based.
 - 2. System shall leverage existing structured cable plant, which is typically consisting of multi/single mode fiber optic backbone and horizontal Cat6.

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3. System shall have sufficient capacity for expansion without the need of adding equipment to the head end equipment.
4. System endpoint devices shall be in compliant to applicable standard TCP/IP e.g. IP Multicast, DHCP, DNS, NTP.
5. System endpoint devices shall support IEEE 802.3af or 802.3at.
6. System shall support IETF SIP.
7. System shall be capable of connecting exchanges, IP network audio adapters, IP amplifiers, IP speakers, IP paging stations and various gateway types interfacing to the IP networking infrastructure e.g. LAN, WAN.
8. System shall provide interfaces for full integration with VoIP Telephone systems for emergency 911. The classroom phones shall be provisioned for direct dialing to a 911 operator.
9. System shall be provisioned for direct outbound dialing.
10. System shall be provisioned for inward dialing using the main school number and an extension number.
11. System shall provide local and/or remote authentication e.g. 802.1X, LDAP for system central management, administration, performance tuning, maintenance, and troubleshooting over the IP network.
12. System shall be capable of providing as a minimum three levels of accessibility rights. The levels correspond to multiple user access rights and individuals or group roles and responsibilities as follows:
 - a. Level 1: System Engineer – A person at the enterprise level who possesses an in-depth system knowledge and is responsible for the overall system installation, configuration, performance tuning, and modification.
 - b. Level 2: System Technician – A person who possesses relevant skillset, techniques, with a relative practical understanding the system to provide field troubleshooting/resolution in order to support end users.
 - c. Level 3: End User – A person who uses the system on the regular basis.
13. System shall provide set up tool that will view all IP endpoints inventory and provide complete individual, group, or all device programming of those endpoints.
14. System shall provide secured access interface for daily functions such as audio files, events, bell schedules, emergency broadcast, emergency bell schedules, graphical interface, and text to speech.
15. System shall provide the ability to replace an IP device without the system having to be disabled during set up of new device.

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16. Service shall not be interrupted while replacing an IP endpoint device and setting up the new device.
17. System control shall allow:
 - a. Minimum of 100 independent operating groups/zones.
 - b. Speaker volume shall be software adjustable to individual zones, multiple zones, individual or group of speakers.
 - c. Configuration of individual device or group(s) of devices e.g. zone-specific requirements, endpoint device firmware upgrade.
 - d. Alarm notification to administrators/support staff via SMS text or email of non-functioning components that need to be serviced.
18. System shall allow duplex conversation between stations, selective or master call to page all stations, background music or audio playback for common audio digital formats e.g. MP3, WAV, and WMA.
19. System shall provide capability and option to integrate with mass notification systems. System IP endpoints shall be Mass Notification ready and be accessed via the District Office in an emergency.
20. System shall employ echo cancellation that prevents acoustic feedback and echo for duplex hand-free conversations between stations.
21. All call paging access to individual speaker, zone paging, all calls, other rooms, etc. System also provides master clock or interface with the existing master clock system for a class change signaling system, and Fire Alarm system override of PA tone signaling capability and inhibition of all audio outputs including speakers and gateways during a fire alarm event.
 - a. The system shall be equipped with a separate circuit to inhibit all loudspeakers audio outputs when a separate relay contact closure occurs from the Fire Alarm system. The closure shall also require activation of the muting relay circuits to all autonomous PA systems.
22. System shall provide the following Functions and Features:
 - a. Scheduling – class change, bus loading, calendar based, standard or non-standard year-round.
 - b. Emergency and overhead paging – send messages to any endpoint e.g. speakers, overrides all communication systems in event of sending/receiving critical messages.
 - c. The system shall automatically reset all clocks at the pre-programmed times and dates of the start and end of daylight-saving time.
 - d. The system shall be capable of interfacing with access control systems to initiate immediate lockdown control of all doors.

C. Intercommunication System:

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1. Communication hardware shall be furnished with the capacity for internal communication between operator and selected classrooms. Calls from classroom telephones shall be enunciated by an alerting tone and shall appear on liquid crystal display (LCD) on an administrative telephone in Main Office.
2. The main operator shall be able to answer calls in sequence by depressing one button on administrative phone, or out of sequence by dialing the number of the desired classroom.
3. Calls to classrooms shall be announced by either a tone signal over the classroom speaker or by ringing the staff telephone.
4. Predetermination as to whether to ring the telephone or to permit talking over the speaker shall be user selectable when dialing.
5. Direct Dial Telephones: A direct-dial telephone system with electronic switching shall be furnished to accomplish the above description. The central switching private exchange or VoIP communication manager shall utilize standard touch tone signaling in compliance with standard telephone practices and operation.
6. Administrative Telephones: Administrative telephone communication system shall provide the following minimum requirements:
 - a. Shall be a standard touch tone dialing telephone equivalent to those employed by public telephone carrier companies.
 - b. Capability as provided for direct dialing, private, two-way telephone communication between all locations furnished with administrative telephone and staff telephone shall be provided.
 - c. Capability as provided for any administrative telephone to transfer a call from another administrative telephone or any staff or classroom telephones to any other telephone.
 - d. Capabilities, as provided for the instantaneous distribution of emergency announcements simultaneously to all locations furnished with loudspeakers.
 - e. Provisions for restricting access to the emergency announcements to certain administrative telephone. This shall be accomplished by the use of an authorized administrative system programming or secured access interface.
 - f. Capabilities as provided for the origination of normal and priority emergency calls from any staff station. Priority emergency calls shall take precedence over normal calls.
 - g. Capabilities as provided for directory lookup and dial by name.
 - h. Provisions for instantaneous distribution of announcements to prescheduled groups of speakers from an administrative telephone.
 - i. Local diagnostic functions shall be provided to simplify maintenance.
 - j. Programming: Authorized administrative system interface or telephone shall be able to distribute announcements to each individual speaker, intercom, zone page a group of speakers, or distribute all-call.

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- k. Volume level shall be software adjustable to individual zone, multiple zones, individual speaker or group of speakers.
 - l. Audio level of the telephone intercommunication system shall be adjustable at sound levels sufficient to override typical ambient school noise.
 - m. Upon notification from the CONTRACTOR, the OAR shall contact the Network Operations and Telecommunications Branches of OWNER to arrange for ordering of necessary additions to the voice system to complete the installation of the PA-Intercom system. Any work to the VoIP system will be provided by the OWNER to encompass both hardware/software additions and any necessary programming and is outside of the scope of this specification. The Network Operations Branch or Telecommunications Branch will manage all connections to the VoIP Telephone system. Any vendor working on the telecommunications system must be pre-approved by the Network Operations Branch or Telecommunications Branch prior to any work commencing.
- D. Public Address: The system shall provide the following:
- 1. Reproduction of speech shall be clear, high fidelity and with all frequencies within range of system faithfully reproduced with no detectable noise, humming or distortion.
 - 2. Reproduction of speech shall be attained at sound levels sufficient to override noise levels typical for schools.
- E. Mass Notification Capabilities for Integration to:
- 1. Conduct Wide Area Mass Emergency Notification from a central control station to all schools, group of schools, a single school, multiple campus zones, in-building, group of classrooms, or individual classroom.
 - a. Situation may include emergency, non-emergency, other events.
 - b. Message types may include pre-written, Text-to-Speech, pre-recorded, and dynamic.
 - c. Notification may be triggered from system authorized administrative application interface, manual desk phones, web access, cell phone, or email.
 - d. Recipients may include students, school and central administrative staff, first responders, and parents.
 - 2. Notification receiving devices may include but not limited to TV broadcast via District owned and operated KLCS Television station, landline/cellular phones, overhead speakers, SMS/Text messages, automated voice calls, email alerts, social media networking, or desktop.
 - 3. Any reproduction of speech shall be attained at sound levels enough to override noise levels typical for schools.

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1.09 SYSTEM DESCRIPTION

The Public Address/Intercommunications system shall be comprised of 2 integrated systems which shall provide means of performing public address functions and telephone.

A. Public Address and Intercom System.

1. Shall provide standard RCA jack for audio messages or music-on-hold (MoH) source input e.g. MP3, CD/DVD players.
2. Any handset on the PA-Intercom shall be able to initiate paging/intercom functions with a pre-program key or dialing a 5-digit key sequence.
3. The all page output with contact closure shall be connected to the telephone signal and telephone page control inputs on the intercom/program distribution control panel.
4. Automatic class change signaling system shall include manual controls to select program and to do all call. The number of class change signaling systems shall be determined by the number of learning communities or other academic entities at the site. The Public Address and Intercommunication system shall be able to support multiple class change signaling needs, by providing additional zones and tones. The class change tones shall be independently programmed to target each learning community on the campus. The selected tone shall be distributed over the loud speaking intercom and P.A. system. In Middle and High schools, the class change signaling system shall be programmed to include dressing and cleanup tones for gymnasiums and shop zones.

B. The intercommunication system shall provide communication between classroom telephones, speakers, administrative phones and VoIP Telephone system and shall operate in conjunction with Public Address equipment. The system shall provide the following features and capabilities:

1. VoIP Telephone system shall be the main backend for all call processing.
2. Integration between the VoIP and PA shall allow paging to the overhead speakers from the VoIP phones.
3. Integration may include but not limited to:
 - a. FXO, FXS, T-1 interfaces
 - b. SIP over IP infrastructure
4. System shall be ADA compliant, the equivalent functionality of 2554 type wall mounted or 2500 type desk phones.
5. System shall provide intercom system dial tone for loop start trunk ports from the VoIP Telephone or IP Router.
6. System shall allow calls from the VoIP Telephone to individual intercom stations or to access page functions.

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7. System shall be provisioned to allow minimum of eight simultaneous calls from the intercom system to outside lines. Intercoms: System shall provide VoIP phones with equivalent functionality of the 2554 or 2500 series in all rooms.

PART 2 - PRODUCTS

2.01 SYSTEM EQUIPMENT

The Public Address/Intercommunications Systems shall include the following equipment and components as identified on the project contract documents.

- A. System Equipment Rack:
 1. The PA-Intercom Head End Equipment shall be installed inside the Main server room MDF cabinet.
- B. Uninterruptable Power Supply (UPS)
 1. All PA-Intercom Head End Equipment and Head End network switches that support PA-Intercom connections shall be energized via a 90 minutes runtime battery backed UPS system.
 2. All ESM network switches that support PA-Intercom field devices shall be energized via a 90 minutes runtime battery backed UPS system.
 3. UPS systems shall support a native SNMP network management interface.
- C. PA-Intercom Head End Processor
 1. The PA-Intercom Head End Processor shall support the following services:
 - a. Contain the system software that controls system features, functions, scheduling of calendar-based events, daily announcements, tones, connections, zones, audio, data and
 - b. Provide all controls necessary for multi-participants conference calls, where applicable, and two-way intercom communication between any stations.
 - c. Shall provide automatic controls to adjust the emergency page volume, supervisory tone volume, time tone and to enable or disable the supervisory tone phantom power to microphone inputs.
 - d. Provisions shall include permitting emergency 911 dialing from classrooms and instructional support/administrative areas.

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- e. Provisions shall include service availability when WAN/MAN circuits are out of service via direct connection to PSTN e.g. local SIP trunk, PRI or POTS lines.
- f. Provisions shall be included to permit emergency paging from a remote telephone, or microphone, which shall capture system priority and override all functions except for the emergency page feature.
- g. Provisions shall provide all controls necessary for distribution of general announcements or program material to any or all classrooms, and transmission of emergency announcement to all classrooms.
- h. Shall support secured web based configuration support for all PA-Intercom.
- i. Shall support secured administrative login access.
- j. Shall support Common Alerting Protocol (CAP) allowing interoperability with public alerting systems.

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2. PA-Intercom Head End Processor hardware shall be provided with the following specification requirements:
 - a. Equipped with SSD
 - b. Minimum of one 10/100/1000 Mbps Ethernet interface; must be capable of supporting a second 10/100/1000 Mbps Ethernet interface.
 - c. Shall be capable of supporting FXO/FXS interfaces and SIP allowing integration with PBX or VoIP systems.
3. Shall provide server disk image which include Operating System (OS), all applications and final site configuration for quick service restoration.
4. Shall provide management capabilities:
 - a. Access locally or via programming software or secured web (SSL) interface
 - b. Support local and centralized management for PA/IC system administration, regular maintenance, configuration, and system performance tuning and troubleshooting.
 - c. Support 802.1X, Active Directory, and LDAP for secured access from anywhere on the District IP network.
 - d. Support multiple user/group access privilege levels for their corresponding roles and responsibilities.
 - e. Support SNMP for server status monitoring.

D. PA-Intercom VOIP Telephone Handsets:

1. VOIP telephone handsets shall be OWNER Furnished CONTRACTOR Installed.
2. The District shall provide The CONTRACTOR a Bill of Materials listing all proposed VOIP telephone handsets to be installed by the CONTRACTOR.

2.02 GROUNDING

Wiring enclosures, terminal cabinets, outlets, frames of cabinet racks and other enclosures shall be grounded in accordance with requirements of California Electrical Code and as specified, and as indicated in the ANSI/EIA/TIA applicable standard.

2.03 SPEAKERS AND ACCESSORIES

- A. Loudspeakers shall meet or exceed the following performance specification:
 1. At the minimum, equipped with one 10/100 auto negotiate Ethernet interface

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2. Support 802.3af or 802.3at
 3. Support DHCP and static IP addressing
 4. Each loudspeaker mechanism shall be mounted in flush back-box or surface baffle as indicated on Drawings and as specified.
 5. Adjust power delivered to each speaker, as necessary, to insure a satisfactory sound level, with reproduction of good quality, in each of locations where speakers are installed.
 6. Loudspeaker Volume Controls: Loudspeaker volume controls shall be adjustable from the server via administrative programming or secured web interface (SSL).
 7. Loudspeaker audio performance shall meet or exceed the following:
 - a. Average Sensitivity: 95 dB SPL, 1W/1M
 - b. Loudspeaker Power Rating: 12W RMS EIA 426A Standard
 - c. Maximum Power Rating: 15W @ 8 Ohms
 - d. Calculated Output: 102 dB SPL 5W/1M
 - e. Frequency Response: 65 Hz - 17 kHz EIA 426A Standard
 - f. Nominal Coverage Angle: 100° Included Angle -6 dB / 2 kHz, Half space
- B. Horn Loudspeakers shall meet or exceed the following criteria:
1. Horn loudspeakers shall be provided in 15-Watt and 30-Watt options.
 2. 15-Watt Horn Loudspeakers shall be furnished for outdoor areas such as lunch shelters, arcades, and walkways.
 3. 30-Watt Horn Loudspeakers shall be furnished for large outdoor areas such as playgrounds, physical education fields, and athletic fields.
 4. Horn Loudspeakers shall meet the following performance specifications:
 - a. Network interface shall support at the minimum one 10/100 auto negotiate Ethernet interface
 - b. Network interface shall support 802.3af or 802.3at
 - c. Network interface shall support DHCP and static IP addressing
 - d. Horn Loudspeakers shall be weatherproof vandal-resistant type.

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- e. Horn Loudspeakers shall be installed with weatherproof cover plates with plastic bushed holes in plates to admit waterproof cable to speaker in drip loops.
 - f. Each horn speaker assembly shall be mounted in a vandal-resistant steel enclosure.
5. Horn Loudspeaker audio performance shall meet or exceed the following:
- a. Average Sensitivity: 120dB at 15 Watts (peak) 114dB at 15 Watts / 1 Meter (avg) 700-5,500Hz
 - b. Minimum Loudspeaker Power Rating: 12W RMS EIA 426A Standard
 - c. Maximum Power Rating: 15W/30W @ 8 Ohms
 - d. Calculated Output: 102 dB SPL 5W/1M
 - e. Frequency Response: 600-14,000Hz (nominal) 700-5,500Hz (\pm 5dB)
 - f. Nominal Coverage Angle: 95° (-6dB, 2000Hz octave band)
- 2.04 NETWORK SWITCHING EQUIPMENT
- A. Networking switching equipment shall be OWNER Furnished CONTRACTOR Installed.
 - B. The District shall provide The CONTRACTOR a Bill of Materials listing all proposed Network Switching Equipment to be installed by the CONTRACTOR.
- 2.05 IP TALKBACK AND ONE-WAY SPEAKER
- A. At the minimum, talkback speaker shall support:
 - 1. At the minimum, one 10/100 auto negotiate Ethernet interface
 - 2. IEEE 802.3af or 802.3at
 - 3. Network Time Protocol (NTP)
 - 4. DHCP or statically IP addressable
 - 5. Software volume control capability per speaker
 - 6. Frequency response 80Hz to 15kHz
 - 7. Input: 45 Ω / 12Watts
 - B. One-way speakers
 - 1. At the minimum, one 10/100 auto negotiate Ethernet interface
 - 2. IEEE 802.3af or 802.3at
 - 3. Network Time Protocol (NTP)

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4. DHCP or statically IP addressable
5. Software volume control capability per speaker
6. Frequency response: 80Hz to 15kHz

2.06 NON-IP TALKBACK AND ONE-WAY SPEAKER

- A. At the minimum, talkback speaker shall support:
 1. Software volume control capability per speaker
 2. Frequency response 80Hz to 15kHz
 3. Input: 45Ω / 12Watts
- B. One-way speakers
 1. Software volume control capability per speaker
 2. Frequency response: 80Hz to 15kHz

2.07 INTEGRATED IP CLOCK/SPEAKER

- A. As provided, integrated clock/speaker shall support:
 1. At the minimum, one 10/100 auto negotiate Ethernet interface
 2. IEEE 802.3af or 802.3at
 3. Network Time Protocol (NTP)
 4. DHCP or statically IP addressable
 5. Does not require a master clock
 6. Time zones and automatic update system clock for annual Daylight Savings Time and Standard Time changes
 7. Automatic time correction after complete power outage.
- B. Power options
 1. Primary source is PoE

2.08 GATEWAY/CONTACT CLOSURE

- A. IP/Analog gateways
 1. Interfacing field analog devices (e.g. speakers, handsets) to IP network.
- B. Contact Closures
 1. Interfacing the PA-Intercom with other systems (e.g. fire alarm, autonomous PA) for signal overriding.

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2.09 CABLING SYSTEM

- A. All system and sub-components shall be interconnected using the existing standard installed per EIA/TIA-568, 569, 606, 607 specifications data network cabling plant with no further modification. Solutions require non-standard custom cabling terminations are not acceptable.
- B. Addition to the existing cabling plant shall be compliant with 27 0536 Cable Tray and 27 1014 Structured Cabling.

2.010 LABELING

- A. Cable labeling shall be consistent with labeling requirements as defined in specification 27 1014 Part 3-Execution and Installation Subsection 3.04C.

2.011 KEYS AND LOCKS

- A. Provide keys and locks for all cabinets and equipment; locks shall be keyed to a Corbin #90 key, for access to operate equipment and to service equipment.

2.012 PORTABLE EQUIPMENT

- A. Furnish and deliver to the OAR, one auxiliary console microphone with coiled cord and press-to-talk switch.
- B. Portable equipment shall remain in individual boxes and be delivered to the OAR.

PART 3 - EXECUTION AND INSTALLATION

3.01 INSTALLATION

- A. Install equipment as specified, as indicated on Shop Drawings, and as required. Installation shall be in accordance with manufacturers' instructions and applicable codes. Installation shall be in accordance with manufacturers' instructions and applicable codes.
- B. Systems that are re-designed with the intention to increase station or port capacity of systems shall not be accepted.
- C. Systems not installed as manufacturer instructions shall not be accepted.

3.02 RELATED SYSTEM OR SUB-COMPONENT INSTALLATION

- A. Public Address system installation
 - 1. Rack Equipment Installation: All equipment within each rack shall be logically arranged for accessibility of convenient maintenance. Cables to shall be dressed only from the right side of the rack, as viewed from the rear. Cable bundle must be dressed neatly to allow room for system service.
- B. Administrative display telephones

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1. Unless otherwise shown on Contract Drawings, provide, program, install and connect a minimum of one administrative telephone in the Main Office, in each Academic Entity on the campus SLC and in each Academy.
- C. Intercom instruments
1. Wall-mounted: Install where indicated modular wall plate.
 2. Desk mounted: Install and connect where indicated and specified.
- D. Special programming requirement
1. Privacy
 - a. The system shall be configured to prohibit the initiation of a two way conversation from any telephone or speaker to any speaker connected to the system without the presence of a supervisory or permitted privacy. This requirement extends to calls from the office to any classroom, from a classroom to any other classroom and from any classroom to any office.
 - b. The tone shall have sufficient volume to alert the occupant of a classroom with typical ambient sound that a two-way communications path has been initiated.

3.03 CERTIFICATIONS AND TESTING

- A. Provide all instruments for testing and demonstrate, in presence of the OWNER, that all circuits and wiring test free of shorts and grounds.
- B. Provide test and reception gear to test for specified performance of active equipment.
- C. Furnish all labor, instruments, appliances, equipment, and materials necessary to demonstrate to the OWNER the installation performs as required and specified.
- D. Before Substantial Completion, submit test results and related documents to the IOR.
- E. The OWNER reserves the right to perform independent tests of equipment furnished, to determine whether or not equipment complies with requirements specified, and to proceed in accordance with the Contract Documents.

3.04 PROJECT RECORD DOCUMENTS

- A. As-Built Documentation
 1. Provide 3 Blue line copies size E (30" X 42") of Project site and building plans, indicating location of equipment, conduit, cable routing, ground vaults terminal cabinets, pull boxes and other installation information.
 2. Provide 3 copies on USB flash drive of the system CPU programming and configuration.

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3. Provide two copies of the record Drawings in PDF or BIM on a USB flash drive for use on a Windows platform.
 - a. OWNER utilizes layers as a key tool in controlling visibility of drawing elements and to provide consistent information between drawings yet provide control over what is seen on each sheet. Public Address wiring shall be shown on a separate layer, labeled as "Public Address" that uses both building floor plans and conduit supporting structure layers below. The use of any version control that blocks or company logo(s) shall be on a layer separate from the premise wiring as-built drawings.
 - b. All software copies supplied shall be multi-layer drawings, consistent with District AutoCAD standards. The following separate layers are expected in all drawings:
 - (1) Title blocks.
 - (2) Buildings
 - (3) Site plan.
 - (4) Separate layers for equipment, devices, cabling and other system components.
 4. Floor plans indicating all devices, terminal cabinets and cross connect locations, conduit runs, ground vaults, wire types, cable routing of all cables, both underground and in each building with conduit fill and count, and as-built coding used on each cable.
 - a. Drawings shall include block diagrams indicating all items and their point-to-point connections in a manner following floor and site plan layout. Drawings shall also include as-built single line diagram, cable site plot plan and floor plans indicating all cables, both underground and in each building with conduit, and as-built coding used on each cable.
 - b. Floor plans shall indicate all devices, terminal cabinets and cross connect locations, conduit runs, ground vaults, wire types, cable routing of all cables, both underground and in each building with conduit fill and count, and as-built coding used on each cable
- B. Operating and Servicing Manuals, Record Drawings:
1. Deliver three copies of operating and servicing manual. Each complete manual shall be bound in three ring binders and all data shall be typewritten or drafted.
 - a. Each manual shall include a page with Project site and Project name, date of Substantial Completion, CONTRACTOR name, address, telephone, and fax numbers.
 - b. Each manual shall contain a letter, signed by an officer of the company indicating the beginning and ending date of any warranties described in subsection 1.07 of this specification and shall describe the companies' commitment to service the warranty during the terms specified.

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- c. Each manual shall include all instructions necessary for proper operation and servicing of system and shall include:
 - (1) A single line diagram of the system indicating all items and their point-to-point connections in a manner following floor and site plan layout.
 - (2) A complete 2 wire diagram of all connections made between components inside the system console.
 - (3) A wiring destination schedule for each circuit leaving console and each rack.
 - (4) All custom fabricated circuits, components and connections not detailed in the manufacturer's manuals shall have wiring diagrams detailing to component level, and the way circuits are connected. Provide details of input/output voltages and input/output signal levels.
 - (5) A schematic diagram of each amplifier and other components, transistor complements and replacement part numbers.
- d. Each manual shall also include as-built single line diagram, cable site plot plan and floor plans indicating all cables, both underground and in each building with conduit, and as-built coding used on each cable. Drawings Size A (8-1/2 inches x 11 inches) and size B (11 inches x 17 inches) shall be bound into the manual. Larger drawings shall be folded and inserted into transparent envelopes bound into the manual. Programming forms of each system shall be submitted with complete information.

3.05 CLEANUP

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

3.06 TRAINING

- A. Before Substantial Completion, provide an eight-hour training instruction period to designated OWNER personnel. Contact OAR first, if assistance is needed in scheduling an appropriate time, location, or list of attendees for this training.
- B. Instruction shall be based on manufacturers written operating instructions covering those features of interest to the OWNER and applicable to the Work. Instruction shall include the following:
 - 1. Making normal calls from intercom telephone to other intercom telephones or to the intercom administrative station. Revisit office staff preferred method for clarity and understanding of function and methodology.
 - 2. Answering normal calls from intercom telephones.

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3. Transferring loudspeaker intercom calls from the speaker to the intercom phone.
 4. Answering normal or emergency calls from the intercom administrative station.
 5. Returning calls shown in the administrative station display queue.
 6. Answering calls shown on the wall display from VoIP Telephone phones (remote answer feature).
 7. Answering calls ringing at a secondary station from admin phone or assigned intercom phone.
 8. Placing calls from VoIP Telephone to other phones.
 9. Placing calls from intercom stations to VoIP Telephone phones.
 10. Placing calls from intercom telephone to the public switched telephone network (PSTN).
 11. Making an emergency all call from the rack, program all call, zone all call and individual announcement from the admin telephone and VoIP Telephone, and all-call from the hand held microphone located in the main office. Explain that emergency all-call from rack activates the hearing assistance system. Also explain where these hear assistance systems and the autonomous systems are located.
 12. Show distribution of radio and media player programs.
 13. Provide copies of manufacturer user's manual to training staff and explain all users' manual functions described. Provide 3 quick user's functions reference guides in a plastic laminated form. The training shall include hands on equipment.
- C. After Substantial Completion and before contract completion, provide two additional one hour "refresher" instruction sessions at times agreed upon by the OWNER.

END OF SECTION

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SECTION 27 51 29 - AUTONOMOUS PUBLIC ADDRESS SYSTEMS (GYMNASIUM)

PART 1 - GENERAL

1.01 SUMMARY

- A. Principal items of Work in this Section include but are not limited to:
1. Autonomous public address (PA) system for middle and high schools.
 2. Conductors and terminal strips to provide for functions.
 3. Labor, engineering, design, testing, materials, components, and supervision necessary to provide a complete operable installation.
- B. Related Requirements:
1. Division 01 – General Requirements.
 2. Section 26 0500: Common Work Results for Electrical.
 3. Section 26 0513: Basic Electrical Materials and Methods.
 4. Section 26 0519: Low Voltage Wires (600 Volt AC).
 5. Section 26 0526: Grounding and Bonding.
 6. Section 26 0533: Raceways and Boxes Fitting and Supports.
 7. Section 26 2416: Panelboards and Signal Terminal Cabinets.
 8. Section 26 5200: Emergency Power Systems.
 9. Section 27 5116: Public Address and Intercommunication Systems.
 10. Section 27 5127: Autonomous Public Address Systems (Small gyms, Multi-Purpose Rooms, ES).
 11. Section 27 5128: Autonomous Public Address Systems (Auditoriums, Performing Arts, Multi-Purpose Rooms; MS and HS).
 12. Section 27 5313: Clock and Program System.
- C. Acronyms:

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DTMF	Dual Tone Multiple Frequency
IC	Intercom
LCD	Liquid Crystal Display
OAR	Owner Authorized Representative
PA	Public Address
PABX	Private Auxiliary Branch Exchange

1.02 SYSTEM REQUIREMENTS

- A. Reproduction of speech shall be clear, high fidelity, and with all frequencies within range of system faithfully reproduced with no detectable echo, noise, hum, or distortion. This shall additionally apply to the audio from the main PA heard in the gymnasium.
- B. Audio level of system shall be attained at sound levels sufficient to override noise levels typical for schools' gymnasium, to provide a satisfactory and serviceable system.
- C. Entire system shall be supported by engineering documentation including:
 - 1. Floor plans indicating devices, conduit runs, wire types, and terminal cabinets.
 - 2. Block diagrams indicating items and their point-to-point connections in a manner following floor plan layout.

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Catalog cuts, technical data, and descriptive literature on components. Data shall be clearly marked and noted to identify specific ranges, model numbers, sizes, and other pertinent data.
 - 2. Submittals shall be bound and shall contain an index organized vertically by assembly and item number and horizontally by columns.
 - a. The first assembly shall be the major head end equipment.
 - b. The leftmost column shall be the item number; next shall be the description, followed by the applicable specification section number, and followed by the specified item, which is followed by the submitted item.
 - c. The rightmost column shall be for notes, which shall be used to reference the reason for submitting items other than as specified.

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3. Submittals shall contain product data sheets or catalog cut sheets for each item listed in the Index. These shall be arranged in the same order as the index and if more than one item is shown, the submitted items shall be highlighted or marked with an arrow.
 - a. The product data shall be sufficiently detailed to allow the Architect to evaluate the suitability of the product and to allow other trades to provide necessary coordination.
4. Provide Shop Drawings, in the same size as the Record Drawings. Shop Drawings shall be prepared in latest version of AutoCAD with three CD-ROM electronic copies submitted along with full sized Shop Drawings.
 - a. Provide a complete set of scaled drawings of racks, consoles, and cabinets with designations, dimensions, color, operating controls, instrument wiring, and schematic diagrams of circuits, following Drawings as baseline.
 - b. Shop Drawings shall provide details as to interfaces of equipment of other Work, identifying numbers of wires, termination requirements, voltages, and other pertinent details. Include front elevations, cabinet dimensions, types of mounting, doors, barriers, catalog number of locks, and finishes for terminal cabinets.
 - c. Include a dimensional Shop Drawing of console nameplate. Nameplate shall contain school name, firm, address, telephone number for warranty and maintenance, and power load.
 - d. For Signal Terminal Cabinets: (Refer to Structured Cabling (New Sites) Specification, Section 27 1014) Include a front elevation indicating cabinet dimensions, make, location and capacity of equipment, size of gutters, type of mounting, finish, and catalog number of locks. General layout of internal devices, wiring drawings with wire numbers and device connections, cut sheets of devices in enclosure and bill of materials listing description, manufacturer, part number, and quantity of items shall be included.
 - e. Shop drawings shall indicate equipment locations, wiring and schematics, details, panel configurations, sizes and a point-to-point wiring diagram of circuits. Shop drawings shall indicate interfaces to equipment furnished by others, identifying numbers of wires, termination requirements, and other pertinent details. Responsibility for each end of interfaces shall be noted on shop drawings.
 - f. Submit Drawings prepared, signed, and sealed by structural engineer licensed in the State of California. Details shall be provided indicating

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the proposed means of support and attachment of speakers and wall and floor mounted racks. Calculations shall be based on the maximum seismic loads as determined by the CBC based on specifications provided by the cabinet manufacturer.

5. Contractor shall have completed at least five projects of equal scope to systems described herein and shall have been in the business of supplying and installing specified type of systems for at least five years. Include the telephone number of the customer's client contact for each project.
6. Include in the Material List Submission copies of the manufacturers' certifications that the Contractor is an authorized distributor and service provider of the submitted manufacturers' products and Contractor's staff has been adequately trained and certified in the installation of those products.
7. Provide a letter from the Manufacturer warranting the availability of spare parts common to proposed system for a period no less than five years on components
8. Calculations: Power load of PA system shall be calculated on a separate sheet and shall be included in submittal.
9. Design Analysis: Submit an electro-acoustical design analysis for review. Provide scale drawings indicating plans and sections of the gymnasium along with an elevation of the cluster. One drawing shall indicate contours with the maximum predicted sound pressure level for the 1KHz octave with a band limited pink noise test signal. Another drawing shall indicate the calculated area within which the specified electro-acoustic frequency response may be maintained for the first arrival sound from the cluster. Submit the name and the organizational affiliation of the individuals responsible for performing the electro-acoustical design analysis. Submit evidence, including appropriate certificates, that these individuals are trained in the specified modeling application. The design shall be generated by or based upon the output of a Computer Aided Electro-Acoustical Design Program such as Ease, Acousta CADD, Bose Modeler, EAW SMAART or equal.

1.04 CODES AND STANDARDS

- A. Complete installation shall meet or exceed the latest edition of following standards.
 1. EIA/TIA-568: Commercial building telecommunications wiring standard.
 2. EIA/TIA-569: Commercial building standard for telecommunications pathways and spaces.

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3. EIA/TIA-606: Administration standard for telecommunications infrastructure of commercial buildings.
4. EIA/TIA-607: Commercial building grounding and bonding requirements for telecommunications.
5. CCR Part 2 - California Building Code (CBC).
6. CCR Part 3 - California Electrical Code (CEC).
7. ANSI, ASTM, UL, NEMA, IEEE and FCC standards as applicable.
8. BICSI Telecommunications Distribution Methods Manual, current edition.

1.05 QUALITY ASSURANCE

- A. Work shall conform to CCR, Title 24 Part 3, Basic Electrical Regulation and National Electrical Code, latest edition.
- B. Only a qualified Contractor holding licenses required by legally constituted authorities having jurisdiction over the work, shall do the work.
- C. Persons skilled in trade represented by work, and in accordance with applicable building codes, shall install system in accordance with best trade practice.
- D. Work shall be performed by a Contractor that has completed at least five school systems of equal scope to system described herein and shall have been engaged in business of supplying and installing specified type of systems for at least five years. Contractor shall maintain a fully equipped service organization capable of furnishing repair service to equipment
- E. Use adequate numbers of skilled technicians who are manufacturer certified, thoroughly trained and experienced on the necessary crafts and completely familiar with the specified requirements and methods needed for the proper performance of the work.
- F. Coordinate cable runs, loudspeakers, speaker horns and rack equipment locations with the OAR prior to start of any work. Contractor and OAR must agree as to the final location of devices and the cable plant design.
- G. Provide sufficient personnel and tools required to participate in Owners Quality Assurance Testing as detailed in Appendix "A" of this specification.
 1. Items on check list of Appendix "A" will be examined as a minimum at the Public Address Head End, terminal cabinets, microphone pockets and speaker locations. Should the examination show deficiencies related to items

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in the checklist, Owners acceptance testing will be discontinued until corrections have been made. When the Contractor has completed the corrections, a subsequent Quality Assurance test shall be initiated. This procedure is in addition to the system functionality testing required in section 3.02 below.

- H. Design analysis shall be performed by certified individuals under the direct observation of the sound engineer responsible for preparation of the Shop Drawings.
- I. System startup and electro-acoustical testing with TDS Techron TEF25, or equivalent instrumentation shall be performed under the direct observation of the sound engineer responsible for preparation of the Shop Drawings.

1.06 WARRANTY

- A. Warranty that work executed and materials furnished shall be free from defects in materials and workmanship for a minimum period of three years from date of installation acceptance, date of Contract Completion, excluding specific items of work that require a warranty of a greater period as set forth in this Specification. In the event a manufacturer's warranty is longer than three years, the manufacturer's warranty shall be the warranty period. Immediately upon receipt of written notice from the Owner, the Contractor shall repair or replace at no expense to the Owner, any defective material or work that may be discovered before final acceptance of work or within warranty period; any material or work damaged thereby; and adjacent material or work that may be displaced in repair or replacement. Examination of or failure to examine work by the Owner shall not relieve Contractor from these obligations.

PART 2 - PRODUCTS

2.01 ANTENNA AND GROUNDING

- A. Antenna and Accessories:
 - 1. FM Antenna: Provide a Blonder Tongue BTY-2-FM, or equal, all-direction FM dipole antenna in the indicated roof location. Lead-in cable shall be 72-ohm weatherproof coaxial type, furnished with necessary weatherproof matching transformer at each end. Cable shall be Belden 8241, or equal. Provide a weatherproof surge protector, PolyPhaser, or equal with #6 AWG grounding conductor to a grounding electrode. The grounding conductor shall be bonded to the mast and surge protector.
 - 2. AM Antenna: Furnish a whip type AM antenna. Insulate antenna from ground. Guy AM antenna whip from mast with an insulated standoff. If signal strength is not adequate from the antenna to provide interference-free reception, provide and install a 30-foot length of hard-drawn 12 gage copper wire

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between new roof antenna masts. Lead-in wire shall be 72 ohm coaxial cable Belden 8241, or equal, and furnished with necessary matching transformers at each end. Provide and install a weatherproof surge protector, PolyPhaser, or equal with #6 AWG grounding conductor to a grounding electrode. The grounding conductor shall be bonded to the mast and surge protector

3. Provide an AM/FM antenna coupler in an outdoor housing mounted on antenna mast. Rauland No. LM0027 or equal.
4. Provide an antenna mast on the roof of the administration building or as indicated on Drawings. Mast shall be 1 ¼-inch galvanized steel and shall be secured to roof joists with steel straps specifically manufactured for specified installation.
5. Provide a ¾ inch antenna conduit from PA console to antenna.

B. Grounding:

1. Wiring enclosures, terminal cabinets, outlets, frames of cabinet racks, and other enclosures shall be grounded in accordance with the requirements of the California Electrical Code, as specified, or required.
2. Chassis of amplifiers, power supplies, and accessories shall be grounded by being bonded to the control cabinet.
3. Housing, grips of microphones, conductive housings, and other equipment shall be grounded by means of grounding wire or shield in cord or cable furnished for equipment connections.
4. Circuits shall be grounded as recommended by manufacturer of equipment to which they are connected unless otherwise specified or required.

2.02 ELECTRONIC RECEPTACLES

- A. Microphone receptacles shall be Cannon XLR/SLR Series, or equal. Receptacles shall be furnished with mounting brackets for floor boxes, Sierra, or equal, 0.040-inch stainless steel plates, unless noted otherwise on Drawings. Each plate shall be engraved with its receptacle function in 3/16 inch high letters filled with black paint. Receptacles shall conform to following:

<u>Type</u>	<u>Description</u>	<u>Model</u>
(A)	Single microphone, Male.	LR-3-14, on a one-gang plate receptacle wall mounting
(B)	Single microphone, Male.	LR-3-14N, with CA015-0094-000 receptacle

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floor mounting yoke.

- B. Speaker connectors shall be Neutrik 2 or 4-conductor jacks specifically provided for the specified installation. Cluster speakers shall be furnished with jacks as required on a custom, brushed, anodized, engraved and filled aluminum plate mounted on 6-inch by 6-inch by 12-inch screw cover box. Connectors for the assistive listening system FM antenna and the central system override speaker shall be located on this panel. Flush or surface mounting condition and finish shall be as required by the Architect.

2.03 CONDUCTOR/CABLES

- A. Cable for overriding autonomous PA system shall be one twisted pair, No. 18 conductor; West Penn No. CL2 293 or equal. The furnished cable shall be the same type of cable furnished for zone paging, switching, and interfacing.
- B. Cable for microphone and other input sources and speakers shall be one twisted pair of 22 gage stranded tinned copper conductors, polyethylene shielded with an aluminum foil-mylar shield, a 22 gage stranded tinned copper drain wire and polyvinyl jacket. Cable shall be Belden 8761, or equal.
- C. Power cables to speakers in the cluster shall be one jacketed, twisted, stranded 12 AWG pair, West Penn CL3 227, or equal.
- D. Coaxial cables from wireless microphone antennas to antenna splitters and from assistive listening transmitter to antenna shall be RG-58 A/U, Belden 8219, or equal.

2.04 KEYS AND LOCKS

- A. Provide keys and locks for cabinets and equipment. Locks shall be keyed to a Corbin No. 60 key, for access to operate equipment and Corbin No. 70 key, for access to service equipment.

2.05 GYMNASIUM AUTONOMOUS PA SYSTEM

- A. Gymnasium autonomous PA system: Provide the following features and accessories:
 - 1. Equipment shall be contained in a freestanding rack, providing at least 77 inches of total mounting space. Rack shall be not more than 81 3/8-inch high, 22 3/8-inch wide and 18 1/2-inch deep. The rack shall be constructed of at least 15 gage steel, heavily reinforced for maximum strength and durability. Cabinet shall be constructed with mounting rails tapped for No. 10-32 screws on EIA spacing front and rear, and shall be provided with CBC compliant earthquake bracing kits. Calculations for seismic bracing shall be based on the maximum seismic loads as determined by the CBC based on specifications provided by the cabinet manufacturer. It shall be furnished with a hinged and

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key-locking rear door and shall be finished in black enamel. Rack shall be listed by UL re-examination service.

2. "Program All" and "Emergency All" audio from the main school PA system shall be reproduced in the gymnasium over loudspeaker(s) through a parallel speaker system. An automatic method of muting gymnasium PA system during Emergency All call shall be implemented. The voice audio from the main PA system shall be intelligible in this noisy and highly reflective environment.
3. Mixer/Preamplifier: TOA M-900MK2, or equal. It shall be modular in design for maximum flexibility and shall be furnished with high performance circuitry. Conventional mixer/preamplifiers without modular input and high-performance circuitry are not permitted. Unit shall be furnished with the following features and accessories:
 - a. Provide eight input modules furnished with variable mute, with any combination of TOA input modules. The variable mute circuit shall be screwdriver adjustable over a range of at least 60 dB and capable of being activated by either an external contact closure or the mixture internal priority circuits. Module ports shall be accessible only from the rear and shall be of the plug in type, utilizing ribbon type connectors with gold plated contact.
 - b. Each input shall be furnished with two controls to set the level of each mix. Bass and treble controls shall be furnished and shall provide plus or minus 10 dB cut or boost at 100Hz and 10 KHz, respectively. Tone control defeat switches shall be provided and shall be located in the module port cage to prevent accidentals adjustments.
 - c. Provide output channel, with direct 600 ohm unbalanced, and transformer-coupled 600 ohm balanced taps. Each output channel shall provide an independent mix of the program input and up to six module input. A separate master volume control shall set the overall output level of each mix. Front panel LED output level indicators shall be furnished.
 - d. Frequency response shall be 20Hz to 20 KHz, plus 0, -1dB. Distortion levels shall be less than 0.2 percent at the maximum output and shall be typically less than 0.015 percent. The signal-to-noise ratio shall be 72dB with master control set at maximum. Sensitivity shall be 100mV per 10,000 ohms for the program and module inputs.
 - e. Bridging in or out jacks shall be furnished for each channel, for recording or for connecting either mixing bus to other D-series equipment. Sensitivity for the bridging I/O shall be 100mV/3,000 ohms.

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- f. Mixer/preamplifier shall be designed for continuous-duty service on line voltages of 120 VAC, 60Hz and shall be furnished with an AC line circuit breaker.
4. AM-FM tuner and cassette tape player shall be a Bogen CR-100A, or equal, and shall be furnished with the following features:
 - a. Unit shall mount in standard 19-inch rack and shall require only 3-1/2 inches of vertical space. Unit shall be finished in textured gray, resistant to fingerprints.
 - b. AM radio section shall be furnished with a tuning range of 530 - 1,620 KHz. FM radio section shall be furnished with a tuning range of 87.5 - 108 MHz.
 - c. Back-lit digital readout shall display frequency of station currently tuned, whether AM or FM, and shall indicate stereo status. It shall alternatively display time. A tone control knob, a balance control lever and fader control lever shall be provided. Other furnished front panel controls shall include band selector button, up and down scan buttons, five preset buttons also furnished to store preferred stations.
 - d. Cassette player shall play standard cassettes with exceptional fidelity (50Hz to 8KHz), with less than 0.35 percent WRMS WOW, and shall reverse automatically when it reaches its end. Fast forward, fast rewind and eject buttons shall be provided. There shall be separate visual indicators for cassette operation and stereo reception.
 - e. Unit shall be furnished with a front panel-mounted monitor speaker to permit program monitoring before it is transmitted to schoolrooms or other locations.
 5. Equalizer shall be ElectroVoice EQ-231, or equal, graphic equalizer and shall be furnished with the following features:
 - a. Provide 31 filter sections of 1/3 octave, positioned at standard ISO frequencies from 20Hz to 20 KHz. Each filter shall be furnished with a center detent slide control, which permits up to 15 dB of boost or cut at the center frequency. "RANGE" push-button switch (with LED indicator) shall be provided to switch the boost /cut range 25 dB to 7.5 dB. "HI-PASS" filter push-button switch (with LED indicator) shall be incorporated to provide an 18 dB per octave roll off. There shall be a "BY-PASS" switch (with LED indicator) to permit the equalizer to operate either with the established filter settings or essentially flat. LED level-meter shall provide a visual indication of the level.

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- b. The equalizer shall accept balanced or unbalanced inputs. Input impedance shall be 600 ohms balanced and 10,000 ohms unbalanced. Outputs may be balanced or unbalanced.
 - c. The unit shall be capable of operation from 120 VAC power source. Power consumption shall be seven Watts. A front panel "POWER" switch with LED indicator shall be provided.
 - d. The equalizer shall be designed for installation in standard 19-inch equipment racks with the furnished accessory rack panel kit, Model RPK-56. It shall be provided with a front panel cover to prevent tampering with the established filter settings.
6. Dual-channel power amplifiers for loudspeakers: Amplifier shall be furnished with a minimum FTC output power rating of 500 watts per channel into eight ohms at less than 0.25 percent THD from 20Hz to 20KHz. Hum and noise shall be -100 dB or better referred to rated power output into eight ohms. Amplifier shall be furnished with thermal, short circuit and clipping protection. Provide one amplifier channel for every two horn speakers, at a minimum, and provide a controller module, if specified by the manufacturer, appropriate to the associated loudspeakers for each amplifier to optimize array performance. Amplifier shall be Electro-Voice P2000, Apogee Sound CA8000, QSC CX902 or equal. Amplifier and array speakers shall be the products of one manufacturer.
7. Hearing Assistance System: FM hearing assistance system shall be as manufactured by Phonic Ear, Williams Sound, or equal, and shall be furnished with the following components:
- a. No. PPA 375 base station mounted in a 19-inch rack. The base station shall operate in 72 MHz - 76 MHz band and shall be furnished with remote-mounted antenna to cover a minimum of 500 feet.
 - b. No. PPA-R35 single channel receiver for use by the listener with standard headset connection including headphones. Receiver shall be capable of being clipped to a pocket or belt. Unit shall be furnished with two AA rechargeable nickel Metal Hydride batteries with receivers furnished at 100:4 ratio of seats in the auditorium to receivers provided, but never less than two receivers. Deliver receivers to the OAR before Substantial Completion.
 - c. No. CHG-3512 battery charger organizer. Unit shall be capable of storing or recharging up to 12 receivers at one time. The charger shall be capable of recharging the nickel Metal Hydride batteries without removing the batteries from the receiver. Battery chargers shall be furnished in sufficient quantity to charge provided receivers

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simultaneously, and transmitted to the OAR before Substantial Completion.

8. Relays furnished to switch PA audio circuits shall be a standard sensitivity, plug-in type, Potter Brumfield KP Series, or equal. Coils shall be 24 volts DC. Contacts shall be provided for functions specified herein. Plug-in relays shall be enclosed in dust-tight cases.
9. Provide necessary power supplies, relays, networks, and other components for an operational system as required.
10. Gymnasium loudspeakers: Quantity, selection of coverage patterns and locations shall be as required to provide specified levels and uniformity of coverage for first arrival sound over the required coverage area. Loudspeaker shall be available with a minimum coverage pattern of 60 by 40 degrees and shall provide a frequency range of 50Hz to 15 KHz. Speaker shall have sensitivity of at least 95 dB, 1w, 1m at 1KHz. Provide a custom protective metal enclosure. Speakers shall be Electro-Voice Fri+152 series, Apogee AFI-3, or equal.
11. Floor Microphone Outlets and Power Outlets: Provide floor microphone and power outlets at locations indicated on Drawings. Floor microphone and power outlets shall comply with requirements in other sections of this Specification.
12. Central system override speakers shall be reentrant horns with wide dispersion, Atlas Sound APC-30T, or equal. They shall be mounted with the gym cluster and shall be connected directly to the central system. During emergency all calls, the feed to the local system shall be muted by an override relay controlled from the central system.

2.06 PORTABLE EQUIPMENT

- A. Provide four low-impedance, dynamic cardioid microphones with floor stands. Microphone shall be a Shure Type SM-58, or equal with on or off switch and microphone holders. Microphones will be furnished with 15-foot Shure microphone cables. Floor stands shall be Atlas MS-20, or equal.
- B. Provide one, 100-foot, one-piece microphone extension cable. Provide two cables, 20 gage, shielded, Belden No. 8412, or equal, terminated with Cannon No. XLR-3-11C and No. XLR-3-12C plugs.
- C. Portable equipment shall remain in the manufacturer boxes and shall be transmitted to the OAR before Substantial Completion.

2.07 LOADS ON EQUIPMENT AND COMPONENTS

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- A. Equipment and component parts shall carry continuously, without undue heating or change in rated value; loads connected thereto and rated output loads where such are specified. Equipment shall be properly fused and rated for continuous operation.
- B. Operating voltages on capacitors shall not exceed 60 percent of their rated working voltages.
- C. Operating wattages to be dissipated by resistors shall not exceed 25 percent of their ratings.

PART 3 - EXECUTION

3.01 AUTONOMOUS PUBLIC ADDRESS SYSTEM (GYMNASIUMS) INSTALLATION

- A. Console and Cabinet Rack Equipment Installation: Equipment within consoles and cabinet racks shall be logically arranged for convenient accessibility and maintenance. Equipment shall be mounted on shelves or panels and shall be securely attached.
- B. Amplifiers, power supplies, and other heavy devices shall be mounted in the lowest available rack spaces on steel shelves fabricated by manufacturer of console and cabinet racks. Cabinets, consoles, and panel faces including drawers shall be the same color.
- C. Wiring within console and cabinets shall be installed to conform to standard engineering practice and shall be terminated on terminal strips having a terminal for required external connections. Wiring shall be cabled, laced, and securely fastened in place so no weight is imposed on any equipment, control switches, or terminals. Wires carrying audio power shall be shielded. Input and output circuits and terminal strips shall be installed to provide separation necessary for proper operation. Wires shall be identified by number and chart.
- D. Conductor shields for each system shall be grounded at one location only. Grounding shall be provided within console and cabinet racks. There shall be no metallic connection between systems. Conduits for system and 120 volt AC system shall be bonded together at console and cabinet racks.
- E. Examination and Inspection: Project Inspector shall observe and inspect installation of underground cable runs and main aboveground cable runs. Notify the Project Inspector not less than two working days before commencement of installation.

3.02 OWNERS QUALITY ASSURANCE CERTIFICATION AND TESTING

- A. Provide instruments for testing, and demonstrate in the presence of the Owner that the circuits and wiring test free of shorts and grounds.

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- B. Furnish labor, instruments, appliances, equipment, and materials necessary to demonstrate to the Owner the installation performs as required.
- C. Owner has the right to perform independent tests of equipment furnished, to determine whether or not equipment complies with requirements specified, and to proceed based on results obtained.
- D. The system shall be fully tested and operational before final inspection. Test results shall be provided to the Owner before final inspection.
- E. System startup and electro-acoustical testing with the Techron TEF25 instrumentation or equal shall be performed under the direct observation of the engineer responsible for preparation of the Shop Drawings.
- F. Reproduction of speech shall be clear, high fidelity, and with frequencies within range of system faithfully reproduced without detectable noise, hum and distortion.
- G. With a 0 dB sine wave test signal applied at a line input of the, and with the gain adjusted so that the output has a 0 dB output, and with the 1/3 octave equalizer bypassed, demonstrate that each channel of the Renkus-Heinz P2800 amps can deliver 250 watts RMS or greater into an eight ohm resistive load from 250 to 12.55Hz. Record measurements at 250Hz, 630Hz, 2.5 KHz and 12.5 KHz for each amplifier.
- H. With setup and gain adjusted, as described above, short the balanced line input with a 620 ohm resistor. 20KHz band limited noise at any cluster amp channel output shall be 70 dB below the level required to reproduce 250 watts RMS. Record the measured noise level for each line input to a given amplifier output.
- I. With setup and gain adjusted as described above and with 500Hz test signal, measure the total harmonic generation and noise (THG&N) through the audio chain. THG&N shall be 0.25 percent or less. Record the THG&N for each line input to a given amplifier channel. Record the THG&N from a given line input to each amplifier channel.
- J. With a 1 KHz, 1mV sine wave signal applied to a microphone input, with the gain adjusted so that the sum of stereo electronically balanced output has a 0 dB output, with the 1/3 octave equalizer bypassed, adjust the level of a given amplifier to deliver 250 watts RMS into an eight ohm resistive load. Record the THG&N for each microphone input to a given amplifier channel output. THG&N shall be 0.25 percent or less.
- K. With setup as described above, short the input with a 120 ohm resistor and measure the 20 KHz band limited noise at the output; 20 KHz band limited noise shall be 70 dB below the level required to deliver 250 watts RMS into an eight ohm resistive load. Record the noise level for each microphone input to the given high-frequency cluster amplifier channel output.

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- L. Perform measurement of first arrival sound pressure levels to verify compliance with the reviewed design analysis. System shall be capable of producing first arrival levels of 90 dB SPL Cwt. with band limited pink noise from the 400Hz 1/3 octave band to the 12.5 KHz 1/3 octave band in the center of the last row of fixed seating and in more than 80 percent of the gymnasium when measured with the Techron TEF25, or equal, electro-acoustical testing equipment. One third octave smoothed first arrival levels as measured with the TEF25, or equal, shall demonstrate that the system frequency response is plus and minus four dB over the 400Hz to 12.5 KHz spectrum and in more than 80 percent of the gymnasium. First arrival requirements do not apply to areas in the acoustical shadow of columns, etcetera. Provide full TEF contours at six locations to provide the Architect with information on which to base recommendations for acoustical treatment.

3.03 PROJECT RECORD DOCUMENTS

A. As-Built Documentation

1. Provide three copies Size E (30-inch by 42-inch) of Project site and building plans, indicating location of equipment, conduit, cable routing, ground vaults terminal cabinets, pull boxes and other installation information.
2. Provide two copies of the record Drawings in .DWG format prepared using the most recent version of AutoCAD on a labeled CD-ROM for use on a Windows platform.
 - a. LAUSD utilizes layers as a key tool in controlling visibility of drawing elements and to provide consistent information between drawings, yet provide control over what is seen on each sheet. Public Address wiring shall be shown on a separate layer, labeled as "Public Address" that uses both building floor plans and conduit supporting structure layers below. The use of any version control blocks or company logos shall be on a layer separate from the premise wiring as-built drawings.
3. Floor plans indicating devices, terminal cabinets and cross connect locations, conduit runs, ground vaults, wire types, cable routing of cables, both underground and in each building with conduit fill and count, and as-built coding used on each cable.
 - a. Drawings shall include block diagrams indicating items and their point-to-point connections in a manner following floor and site plan layout. Drawings shall also include as-built single line diagram, cable site plot plan and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on each cable
 - b. Floor plans shall indicate devices, terminal cabinets and cross connect locations, conduit runs, ground vaults, wire types, cable routing of

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cables, both underground and in each building with conduit fill and count, and as-built coding used on each cable

B. Operating and Servicing Manuals, Record Drawings:

1. Deliver three copies of operating and servicing manual. Each complete manual shall be bound in three ring binders and data shall be typewritten or drafted.
2. Manuals shall include a page with Project site and Project name, date of Substantial Completion, Contractor name, address, telephone, and fax numbers.
3. Manuals shall contain a letter, signed by an officer of the company indicating the beginning and ending date of any warranties described in subsection 1.07 of this specification and shall describe the companies' commitment to service the warranty during the terms specified.
4. Manuals shall include instructions necessary for proper operation and servicing of system and shall include:
 - a. A single line diagram of the system indicating items and their point-to-point connections in a manner following floor and site plan layout.
 - b. A complete two wire diagram of connections made between components inside the system console.
 - c. A wiring destination schedule for each circuit leaving console and each rack.
 - d. Custom fabricated circuits, components and connections not detailed in the manufacturer's manuals shall have wiring diagrams detailing to component level, the manner in which the circuits are connected.
 - e. A schematic diagram of each amplifier and other components, transistor complements and replacement part numbers.
5. Each manual shall include as-built single line diagram, cable site plot plan and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on each cable. Drawings Size A (8 ½ by 11) and size B (11 by 17) shall be bound into the manual. Larger drawings shall be folded and inserted into transparent envelopes bound into the manual. Programming forms of each system shall be submitted with complete information.

3.04 PROTECTION

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

3.05 CLEANUP

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

3.06 OWNER ORIENTATION (IF REQUIRED)

- A. Before Substantial Completion, provide a four hour Owner instruction period to designated Owner personnel. Coordinate time and location with OAR. This training may be combined with instruction provided for the public address system.
- B. Instruction shall be based on manufacturers written operating instructions covering those features of interest to the Owner and applicable to the Work.
- C. After Substantial Completion, and before contract completion, provide two additional one hour "refresher" instruction sessions at times agreed upon by the Owner.

END OF SECTION

ATTACHMENT "A"

Safety and Technology Owners Quality Assurance

Site Location

Code / Name _____

Network

Engineer _____ **Project Inspector** _____

PM _____

Recommendation _____ **Electrical**

Owner is to examine the following items based on the criteria defined in this section . If deficiencies are noted, the system will be failed. As a courtesy, Owner will consider continuing testing at a 20 percent rate to determine the integrity of the system.

Autonomous Public Address System Check List	Pass	Fail
Check conduit and raceway layout and installation for each low voltage systems and verify that they meet project specifications and Record Documents.	<input type="checkbox"/>	<input type="checkbox"/>
Examine Head-end equipment installation, cable cross connection, system configuration for compliance with specification and conformance to Record Documents.	<input type="checkbox"/>	<input type="checkbox"/>
Equipment rack installation, including placement in the communications room, seismic bracing and attachment to the floor are in conformance with specification and Structural Engineers Submittal Drawings.	<input type="checkbox"/>	<input type="checkbox"/>
Are cables clearly and indelibly marked?	<input type="checkbox"/>	<input type="checkbox"/>
Is the cross-connect field clearly marked?	<input type="checkbox"/>	<input type="checkbox"/>
Are terminations punched down singly and cross-connected?	<input type="checkbox"/>	<input type="checkbox"/>
Has a wiring index and destination chart been placed within the system console?	<input type="checkbox"/>	<input type="checkbox"/>
Ensure that active components, terminal cabinets, cross connects are located in a secure location.	<input type="checkbox"/>	<input type="checkbox"/>
Verify that normal and emergency announcements from the main PA are intelligible.	<input type="checkbox"/>	<input type="checkbox"/>
Verify that the sound reproduction of the voice audio is intelligible.	<input type="checkbox"/>	<input type="checkbox"/>
Verify that all-call override is in place and functions per Specification.	<input type="checkbox"/>	<input type="checkbox"/>
Verify the functionality of the hearing assistance system. Consider coverage with the room and quality of sound.	<input type="checkbox"/>	<input type="checkbox"/>
Important Note: Failure on any category, constitute failure of the entire system		

END OF SECTION

SECTION 27 53 13 - CLOCK SYSTEM

PART 1 - GENERAL

1.1 SCOPE

- A. Work Included: All labor, materials, appliances tools, equipment, facilities transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
 2. General Provisions and Requirements for electrical work.

1.2 SUBMITTALS (ADDITIONAL REQUIREMENTS)

- A. Submit product data sheets and descriptive literature for all component parts.
- B. Submit block wiring diagram of the clock and paging systems, showing headend equipment, terminal cabinets, remote power supplies, and typical clock for each zone.

1.3 EQUIPMENT QUALIFICATION

- A. The Specification is based on the equipment of Manufacturers who have been approved by the District and the Manufacturers herein named shall be considered as meeting the Requirements of this Specification. For all items which are identified by part number and Manufacturer the Performance Specifications which are published in the most recent Manufacturer's data sheets available at the time of bidding this Project shall be applicable to the present work as though fully written out herein.
- B. All equipment shall conform to all local applicable Codes and Ordinances, and shall be listed by Underwriters Laboratories.

1.4 QUALIFICATIONS

To qualify as an acceptable Bidder, whether the bid is submitted to the District, his Agent, a General Contractor or a Sub-Contractor, the System Bidder or Contractor shall be qualified Sound Contractor and shall hold a valid C61 License issued by the Contractors State License Board of California. The System Bidder or Contractor shall hereinafter be referred to as the Contractor. The Contractor shall hold all other licenses required by the legally constituted Authorities Having Jurisdiction (AHJ) over the work. The Contractor shall be the Factory Authorized Distributor for the brand of equipment offered and shall have been engaged in the business of supplying and installing the specified type of system for at least 5-years. The Contractor shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment.

1.5 GENERAL REQUIREMENTS AND SCOPE

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- A. Furnish and Install a complete new GPS wireless clock system using Primex Wireless Inc. GPS wireless system or equal by American Time and Signal, Sapling. All bids shall be based on the equipment as specified herein.
- B. Section includes Transmission Systems GPS Receiver, Primary Transmitter, and Satellite Transmitter.
 - 1. Clocks:
 - a. Analog
 - b. Digital

1.6 RELATED SECTIONS

Division 26 – Electrical (120 volt grounded outlet required for transmitter).

1.7 REFERENCES

This Technical Specification and Associated Drawings, Primex Wireless GPS Satellite Time System User Manual.

1.8 DEFINITIONS

GPS: Global Positioning System, a worldwide system that employs 24-satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits Universal Coordinated Time, the world's most accurate and reliable time.

1.9 SYSTEM DESCRIPTION

- A. GPS wireless clock system shall continually synchronize clocks throughout the facility, and shall be capable of clock readouts in multiple time zones where desired.
- B. The system shall provide wireless time using GPS and be synchronized to UTC. The system shall not require hard wiring. Clocks shall automatically adjust for Daylight Saving Time
- C. Analog Clocks shall be synchronized to within 10-milliseconds 6-times per day, and the system shall have an internal oscillator that maintains plus or minus 1-second per day between synchronizations, so that clock accuracy shall not exceed plus or minus 0.2 seconds.
- D. The system shall include an internal clock reference so that failure of the GPS signal shall not cause the clocks to fail in indicating time.
- E. The system shall incorporate a "fail-safe" design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal operation without the need to reset the system or any component thereof.

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- F. Clock locations shall be as indicated, and clocks shall be fully portable, capable of being relocated at any time.
- G. The system must operate in accordance with a "Radio Station Authorization", Form FCC 601 – LM, granted by the Federal Communications Commission (FCC). This license will be issued to and held by the end user.

1.10 REGULATORY REQUIREMENTS

- A. Equipment and components furnished shall be of Manufacturer's latest model.
- B. The end user will hold a License, known as a "Radio Station Authorization" granted by the FCC.
- C. This License grants the end user protected use for wireless transmission at the designated frequency.
- D. This License will designate a unique "call sign" for each end user.
- E. Transmitter and Receiver shall comply with Part 90 of FCC rules as follows:
- F. This device may not cause harmful interference, and
- G. This device must accept interference received, including interference that may cause undesired operation.
- H. Transmitter frequency shall be Governed by FCC Part 90.35.
- I. Transmitter output power shall be Governed by FCC Part 90 257 (b)
- J. System shall be installed in compliance with Local and State Authorities Having Jurisdiction.
- K. Operating License: Submit evidence of application for FCC Radio Station Authorization prior to installing equipment. Furnish the license or a copy of the application for the license, to the District/End User prior to operating the equipment. The original license must be delivered to the District/End User.
- L. Samples: Submit one clock for approval. Approved sample shall be tagged and shall be installed in the work at location directed.
- M. Manufacturer's Instructions: Submit complete installation, set-up and maintenance instructions.
- N. Floor Plans indicating the location of system transmitter(s), approved by Manufacturer, will be submitted to District prior to installation.

1.11 QUALITY ASSURANCE

- A. Permits: Obtain Operating License for the transmitter from the FCC.
 - 1. Qualifications:
 - a. Manufacturer: Company specializing in manufacturing commercial time system products with a minimum of 30 continuous years of documented

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experience including 4 years' experience producing GPS wireless time systems.

- b. Installer: Company with documented experience in the installation of commercial timesystems.

- 2. Prior to installation, a site survey must be performed to determine proper transmitter placement.

1.12 DELIVERY STORAGE AND HANDLING

- A. Deliver all components to the site in the Manufacturer's original packaging. Packaging shall contain Manufacturer's name and address, product identification number, and other related information.
- B. Store equipment in finished building, unopened containers until ready for installation.

1.13 PROJECT SITE CONDITIONS

- A. Clocks shall not be installed until painting and other finish work in each room is complete.
- B. Coordinate installation of GPS receiver for access to the roof or exterior side wall so that the bracket and related fasteners are watertight.

1.14 SYSTEM STARTUP

At completion of installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that all clocks are functioning.

1.15 WARRANTY

Manufacturer will provide a 1-year warranty on GPS receiver, transmitter, and satellite transmitter. All other components will have a 1-year warranty.

PART 2 – PRODUCTS

2.1 MANUFACTURER

GPS wireless clock system shall be manufactured by Primex Wireless, Inc., N3211 County Road H, Lake Geneva WI 53147, telephone (800) 537-0464, Fax (262) 248-0061, www.primexwireless.com or equal by American Time and Signal, Sapling.

2.2 SEQUENCE OF OPERATION

- A. Transmitter Operation: When power is first applied to the transmitter, it checks for and displays the software version. It then checks the position of the switches and stores their position in memory. The transmitter looks for the GPS time signal. Once the transmitter has received the GPS time, it sets its internal clock to that time. The

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transmitter then starts to transmit its internal time once every second. The transmitter updates its internal clock every time it receives valid time data from the GPS.

B. Analog Clock Operation:

1. Apply power or insert batteries. Follow set up procedures detailed in Manufacturer's instructions.
2. After initial setup, the clock will shut off the receiver. Six times each day, the microprocessor will activate the receiver and starting with the stored channel, it will again look for a valid time signal. If necessary, the clocks will resynchronize to the correct time.
3. If the clock has not decoded a valid time signal for a pre-determined number of days, it will go to a step mode. Non signal reception can be caused by low battery voltage. If this occurs, replace the batteries.

2.3 EQUIPMENT

- A. General: The clock system shall include a transmitter, a roof or window mounted GPS receiver, indicating clocks, and all accessories for complete operation.
- B. The GPS Receiver shall be a complete GPS receiver including antenna in a waterproof case, designed for roof or outdoor mounting. Provide mounting bracket for attachment to roof structure.
- C. The GPS Receiver cable must be plenum rated where required by local Code.
- D. Transmitter: Primex Wireless Model 14400, consisting of wireless transmitter with GPS receiver, a surge protection device/battery backup, and a mounting shelf. Unit shall obtain current atomic time from satellite. The clock system shall transmit time continuously to all clocks in the system.
 1. Transmission:
 - a. Frequency Range: 72.100 to 72.400 MHz.
 - b. Transmission Power: 1 watt (30dBm) maximum
 - c. Radio technology: narrow band FM
 - d. Number of channels: 16
 - e. Channel bandwidth: 20kHz maximum
 - f. Transition mode: one-way communication
 - g. Data rate: 2 Kbps
 - h. Operating range: 32 degree F to 158 degrees F (0 degrees C. to 70 degrees C).
 2. Transmitter:
 - a. Transmitter output power: +26 to +30 dBm
 - b. Frequency deviation: +/- 4 kHz
 - c. Transmitter Power Requirements: 120 VAC 60 Hz
 - d. Internal Power Requirements: 5 VDC
 - e. Carrier frequency stability: +/- 20 ppm

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3. Transmitter shall have 16 selectable channels to assure interference-free reception.
 4. Transmitter shall have the following switches:
 - a. Time zone adjustment switches for all time zones in the World. Includes Eastern, Central, Mountain, Pacific, Alaska, and Hawaii.
 - b. Daylight Saving Time bypass switch.
 - c. 12-hours or 24-hours display.
 5. Transmitter housing shall be black metal case, 16¾-inches (424.4mm) by 12 inches (304.8mm) by 1-7/8 inches (46.4mm) in size.
 6. Antenna shall be 46-inches (1168mm) high, commercial type, mounted on top center of transmitter housing. Antenna gain shall be < 2.2 dB. Antenna polarization shall be vertical.
 7. Transmitter housing shall incorporate a display which shall include the following:
 - a. Time readout
 - b. AM and PM indicator if 12-hour time display is set
 - c. Day and date readout
 - d. Indicator for daylight savings or standard time
 - e. LED which shall flash red in event of reception problem
 - f. GPS reception indicator
 8. Transmitter shall contain an internal clock such that failure of reception from the GPS will not disable the operation of the clocks.
 9. Power supply (included):
 - a. Input: 120 volt AC 50/60 Hz, 0.4 amps.
 - b. Output: 9 volt DC, 1.5 amps.
- E. Surge Protector/Battery Backup (included).
1. Input: 120 volt AC 60 Hz +/- 1 Hz.
 2. Output: 120 volt AC, 500VA, 300 watts
 3. Surge Energy Rating: 365 joules
- F. Additional Equipment
1. Wireless Receiver Switches: Switches shall receive time packets from the Primary Transmitter and relay the synchronized time to the Satellite Transmitter connected to it. The unit shall include the following:
 - a. Antenna mounted on top of the switch housing, 11½-inches (292mm) long.
Power Supply:
 - 1) Input 120 VAC 50/60Hz, 0.4 amps
 - 2) Output: 9 volt DC, 1.5 amps RS 232 data cable, 5 feet (1.5mm) long
 - b. Daylight Savings Time bypass switch
 - c. Dimensions: 4¼-inches (108mm) long, 5¾-inches (146mm) wide, 1¼-inches (31.75mm) deep.
 - d. Weight: 12 ounces (.34kg)
 - e. Operating Range: 32 degrees F to 158 degrees F (0 to 70 degrees C)

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2. Satellite Transmitters Primex Wireless Model 14401: Satellite Transmitters shall receive the signal from the Wireless Receiver Switches and transmit the signal to the devices in its vicinity, which are out of the range from the Master Transmitter. The unit shall include the following:
 - a. Antenna mounted on top of the housing, 46 inches (1168mm) long.
 - b. Wireless Receiver Switch.
 - c. Power Supply Input: 120
 - d. VAC, 50/60Hz, 0.4-amps
 - e. Output: 9 volt DC, 1.5-amps.
 - f. 6 foot (1.83m) cord
 - g. Surge Suppressor/Battery Backup
 - h. Mounting Shelf.
 - i. Transmission Power: 1 watt maximum
 - j. 72 MHz frequency.
3. Traditional analog clocks (battery): Analog clocks shall be wall mounted. Clocks shall have poly- carbonate frame and polycarbonate lens. Face shall be white. Hour and minute hands shall be black.
 - a. 9 inches (228.6mm) diameter analog clock: Primex Wireless Model 14280
 - b. 12½-inch (317.5mm) diameter analog clock: Primex Wireless Model 14155
 - c. 16 inches (406.4mm) diameter analog clock: Primex Wireless Model 14163
 - d. 24 inches (610mm) diameter analog clock: Primex Wireless Model 14346
4. Additional colors, finishes, and dial faces are available from Manufacturer.
 - a. Analog clocks shall be battery-operated,
 - b. Analog clocks shall be capable of automatically adjusting for Daylight Saving Time. An on-off switch located on the transmitter shall disable this function if desired.
 - c. Time shall be automatically updated from the transmitter 6 times per day.
 - d. Analog clocks shall remember the time during changing of batteries.
 - e. 9 inches (228.6mm) and 12.5 inches (317.5mm) analog clocks shall have a tamper proof/ theft resistant clock lock mounting slots.
5. Analog clock receivers shall be as follows:
 - a. Receiver sensitivity: >-110 dBm
 - b. Receiver power: 24 VAC or 120 VAC (see model #)
 - c. Antenna type: internal
 - d. Antenna gain: -7 dBd

If transmitter stops transmitting valid time signals due to power failure, the clocks will continue to function as accurate quartz clocks until a valid time signal is decoded. If signal transmission is not restored after 96 hours, the second-hand will "five-step" as a visual indicator that the signal has been lost. Should the clocks lose power and signal, the clocks will not function.

6. Wire guards: Provide one for each analog clock as follows:

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- a. Analog clock wire guard Primex Wireless Model 14131, 14-inches by 14-inches (355.6 by 355.6 mm) size, for nominal 12½-inch (317.5 mm) diameter analog clocks.
 - b. Analog clock wire guard Primex Wireless Model 14123, 18-inches by 18-inches (457.2 by 457.2mm) size, for 16 inches (406.4mm) diameter analog clocks.
7. Cable Connection Sealant: Radio Shack Coaxial Cable Connector Sealant 278-1645, or approved electrical grade silicone sealant.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.
- B. Verify that 120-volt electrical outlet is located within 6 feet (1.83m) of location of transmitter and the outlet is operational and properly grounded.

3.2 INSTALLATION

- A. Provide all equipment necessary for a complete and operable system.
- B. Transmitter: Locate transmitter where indicated, a minimum of 2 to 3 feet (.6 to 1 meter) above the floor, away from large metal objects such as filing cabinets, lockers or metal framed walls. Transmitter(s) will be placed at locations indicated below:
 1. Attach receiver to transmitter using cable.
 2. Connect antenna to transmitter, using care not to strip threads.
 3. Connect power supply to the transmitter. Set the channel number on the display to correspond to the FCC license.
 4. Plug power supply into electrical outlet.
- C. Analog clocks shall perform the following operations with each clock:
 1. Set clock to correct time in accordance with Manufacturer's instructions.
 2. Observe analog clock until valid signals are received and analog clock adjusts itself to correct time.
 3. Install the analog clock on the wall in the indicated location, plumb, level and tight against the wall. If using 12½-inch (317.5mm) clock, attach using clock-lock hanging method and suitable fasteners as approved by Clock Manufacturer.
 4. Wire guards: Secure to wall, using approved theft-resistant fasteners.

3.3 ADJUSTING

Prior to final acceptance, inspect each clock, adjust as required, and replace parts which are found defective.

3.4 CLEANING

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Prior to final acceptance, clean exposed surfaces of clocks, using cleaning methods recommended by Clock Manufacturer. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.

3.5 DEMONSTRATION

Provide training to District's Representative on setting and adjusting clocks, replacing batteries and routine maintenance.

3.6 PROTECTION

Protect finished installation until final acceptance of the Project.

3.7 TESTING

All devices must be tested at their operational location under normal operational conditions to assure reception of signal.

END OF SECTION

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SECTION 28 31 00 - FIRE DETECTION AND ALARM

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fire alarm system shall consist of fire alarm control panel or networked nodes of the same make and be CSFM (California State Fire Marshall) listed for the application.
2. Labor, equipment, materials, connections, testing, and performance of operations in the installation of fire alarm system.

B. Related Requirements:

1. Division 01 General Requirements.
2. Section 21 13 13: Fire Suppression Sprinkler Systems.
3. Section 23 38 13: Kitchen Ventilation System.
4. Section 23 80 00: Heating, Ventilating, and Air Conditioning Equipment.
5. Section 26 05 00: Common Work Results for Electrical.
6. Section 26 05 13: Basic Electrical Materials and Methods.
7. Section 26 05 19: Low-Voltage Wire (600 Volt AC).
8. Section 26 05 26: Grounding and Bonding.
9. Section 26 05 33: Raceways, Boxes, Fittings, and Supports.
10. Section 26 55 63: Theatrical Lighting and Stage Dimming Systems
11. Section 27 53 13: Clock and Program Systems.
12. Section 27 51 17: Converged IP Public Address and Intercommunication.
13. Section 27 51 29: Public Address Systems (Auditoriums, Performing Art, M-P Rooms).

1.02 SYSTEM REQUIREMENTS

A. Fire detection system shall continually supervise and monitor the following initiating, signaling, and monitoring circuits:

1. Manual fire-pull stations.
2. Smoke and heat detectors, duct detectors, multicriteria detectors, combination smoke/heat/CO Detectors, including detectors installed under other sections.

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3. Fire sprinkler flow and tamper switches. In existing installations also include PIV tamper switches.
 4. Alarm signaling circuits including alarm bells, horns and visual alarm units.
 5. Annunciators.
 6. Power supplies and batteries.
 7. Interconnection with Central and Autonomous Public Address systems, telephone network system, Clock System-Classroom or Program schedule change, HVAC system where applicable, kitchen fire suppression system, Theatrical and House Lighting, and other systems required by code.
- B. System controls shall be UL listed for power limited applications in accordance with California Electrical Code.
- C. System shall be listed for Internet of Things (IoT) security in compliance with UL 2900.
- D. The fire alarm devices and equipment shall be listed for installation for the fire alarm control panel to which they are being connected.
- E. Complete installation shall conform to the version of NFPA 72, California Fire Code, California Building Code (CBC), and California Electrical Code (CEC) as approved by DSA on stamped drawings.
- F. System labels and devices programming addresses shall be based on final signage and building labeling submittals. For existing facilities contractor shall obtain from Owner Authorized Representative a copy of the current site layout and building labeling designations.

1.03 CERTIFICATION

- A. Certification: Installation of fire alarm system shall not begin until Shop Drawings, including State Fire Marshal listing numbers of fire alarm components, are submitted and reviewed by the Architect. Written certification by fire alarm equipment distributor or manufacturer shall be submitted to the Architect stating that system and its component parts are as approved and listed by the State Fire Marshal, and that the design conforms to requirements set forth in CBC.

1.04 PERFORMANCE

- A. System shall be fully programmable, configurable, and expandable in the field without special tools or PROM programmers and shall not require replacement of memory ICs. Installer shall provide a CD of system installed software, site specific system programming and information and tools required to re-program or modify the system.

1.05 SYSTEM FUNCTIONAL OPERATION

- A. When a fire alarm condition is detected by one of the system alarm initiating devices, the following functions shall occur:

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1. System alarm LED shall flash.
 2. Local sounding device in panel shall be activated.
 3. The LCD display shall indicate type of device, custom label location label and point status alarm condition.
 4. Appropriate change of status message shall be transmitted to remote annunciator(s).
 5. Automatic programs assigned to alarm point shall be executed and associated indicating devices and relays activated.
 6. In the event of a fire alarm control panel activation, manual and automatic electronic tone or electromechanical bell class passing signals shall be disabled.
 7. In the event of a fire alarm condition the Central and Autonomous Public Address System shall be overridden.
 8. UDACT (Universal Digital Alarm Communicator Transmitter) shall activate.
 9. Provide necessary hardware and labor for a complete and tested interfacing of the fire alarm system with the lighting controls systems in Auditoriums, Multi-Purpose rooms, and Gymnasiums; lighting in these areas shall be brought to full brightness in the event of a fire alarm.
- B. Trouble and Supervisory Conditions.
1. When any trouble condition is detected the following functions shall occur:
 - a. System trouble LED shall flash.
 - b. Local sounding device in panel shall be activated.
 - c. The LCD display shall indicate the type of trouble and custom label location associated with the trouble condition and its location. Unacknowledged alarm messages shall have priority over trouble messages. If such an alarm is displayed, then trouble messages shall not be displayed.
 - d. Appropriate message shall be transmitted to remote annunciators.
 - e. UDACT shall activate.
- C. When any supervisory condition occurs such as a sprinkler valve tamper, the following function shall occur:
1. System supervisory LED shall flash.
 2. Local sounding device in panel shall be activated.
 3. Appropriate message shall be transmitted to remote annunciators.
 4. UDACT shall activate.
- D. Activation of control panel ACKNOWLEDGE switch in response to a single new alarm, trouble or supervisory condition shall silence panel sounding device and

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change system alarm, trouble, or supervisory LED from flashing to steady-ON. If additional new alarm, trouble, or supervisory conditions exist in the system; activation of this switch shall advance display to next alarm, trouble, or supervisory condition that exists, and shall not silence local audible device or change LED to steady until new conditions have been so acknowledged. New alarm conditions shall always be displayed before new trouble conditions. Occurrence of a new alarm, trouble, or supervisory condition shall cause panel to resound, and sequences as described above, shall repeat.

- E. Activation of the signal silence switch shall cause appropriate notification (indicating) appliances and relays to return to normal condition. Selection of notification appliance circuits and relays silenced by this switch shall be fully programmable.
- F. Activation of system reset switch shall cause electronically latched initiating devices or zones, as well as associated output devices and circuits, to return to normal condition after sixty seconds of alarm. If alarm conditions exist in system after system reset switch activation, system shall then re-sound alarm conditions as indicated hereafter.
- G. Activation of lamp test switch shall turn on LED indicators, LCD display, and local sounding device in panel, and then return to previous condition.
- H. Fire alarm indicating appliances may be silenced or extinguished, after one minute, by operating signal silence switch at the FACP or by use of key supervised alarm silence switch at remote annunciators. A subsequent zone alarm shall reactivate signals. Audible indicating appliances shall be automatically silenced after no less than five nor more than ten minutes of operation. Visual indicating appliances shall be extinguished at system reset, or automatically after no less than five nor more than ten minutes of operation. Fire sprinkler flow alarm bells shall not silence until the contacts in the fire sprinkler flow switch return to the normal non-alarm state. Appropriate signage must be installed on or next to the sprinkler alarm bell.
- I. System's circuits including but not limited to initiation, indicating, and equipment interfacing shall be monitored for open or short circuit and ground fault conditions, these conditions shall be indicated on the Fire Alarm Control Panel and Annunciator displays while remaining circuits continue to operate normally.
- J. Notification appliance circuits shall be silenceable for testing purposes by authorized persons. Protected pass-codes, keys, or another secure method that does not require entering into the system programming shall be used.

1.06 POWER REQUIREMENTS

- A. The fire alarm control panel and remote power supply shall receive 120 VAC power, 60 Hz, through a dedicated 20 amps circuit. Circuit breaker protection for the dedicated fire alarm power circuits shall be equipped with a handle lock-on device; the breaker handle shall be colored red and labeled "FIRE ALARM". Clearly label the Electrical panel name, location and circuit number on the inside of the fire alarm control panel and remote power supplies using a p-touch style

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labeling system. Transient voltage surge suppression shall be provided at the 120VAC input terminal.

- B. System shall be provided with sufficient battery capacity to operate entire system upon loss of normal 120 VAC power, in a normal quiescent mode, for a period of 24 hours with five minutes of alarm indication at end of this period. System shall automatically transfer to standby batteries upon power failure. Battery charging and recharging operations shall be automatic. Batteries, once discharged, shall recharge at a rate to provide a minimum of 70 percent capacity in 12 hours.
- C. Circuits requiring system operating power shall be 24 VDC and shall be individually protected at control panel.

1.07 SUBMITTALS

- A. Provide in accordance with Division 01.
- B. Component Plan Submittal: Availability and listing for its application shall be verified for system components before presentation of the submittal. Include the following information and details as applicable:
 - 1. Installer name, address, telephone number.
 - 2. List of system components, equipment and devices, including manufacturer model numbers, quantity and California State Fire Marshal listing numbers, mounting heights, and symbols per symbol list.
 - 3. Copies of manufacturer specification sheets for equipment and devices indicated. Highlight or identify the specific components on Catalog cut sheets.
 - 4. Voltage Drop Calculations: Include the following information for the worst case:
 - a. Point-to-point or Ohms law calculations.
 - b. Zone used in calculations.
 - c. Voltage drop percent. Voltage drop shall not exceed manufacturer's requirements. If voltage drop exceeds ten percent, indicate manufacturer listed operating voltage ranges for equipment and devices.
 - 5. Battery types, amp hours, and load calculations including the following:
 - a. Normal operation: 100 percent of applicable devices for 24 hours to equal control panel amps plus list of amps per device that draw power from the panel during standby power condition including, but not limited to, zone modules, detectors and devices as identified.
 - b. Alarm condition: 100 percent of applicable devices for five minutes to equal control panel amps plus list of amps per device that draw power from panel during alarm condition including, but not limited to, the following:

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- 1) Zone modules.
 - 2) Signal modules.
 - 3) Detectors.
 - 4) Signal devices.
 - 5) Annunciator.
 - 6) Other devices as identified.
- c. Normal operation plus alarm operation load calculation shall include total amp hours required and total amp hours provided.
6. Provide one copy of testing procedures.
- C. Shop Drawings: Provide Shop Drawings, in the same size as the design Drawings, include the following:
1. Provide drawing scale, elevations of system enclosures, and actual layout of the Fire Alarm Control Panel, power supply, annunciator, and main system components.
 2. Site Plan indicating PIV and related fire sprinkler system devices and equipment to be monitored or supervised; such as water flow valves, and main equipment such as control panels, power supplies, annunciators, and components such as outdoor wall-mounted horns, sprinkler bells, pull boxes, underground pull boxes, wiring routes on buildings exteriors and underground locations. In each conduit or raceway run indicate conduit sizes, and quantities and type of wires.
 - a. In existing facilities make a distinction between existing and new installation.
 3. Complete battery calculations, and voltage drop calculation shall be included; these calculations shall be based on the devices maximum UL current rating.
 4. One line drawing for the entire system network indicating system components and wiring. The one line diagram shall show but not be limited to panel to panel interconnections, conductors gage and quantity, conduit size and type (designation) and specific function.
 5. System panel one-line drawings indicating the quantity and type (designation) of conductors entering and exiting the fire alarm terminal cabinet in each building (enclosure) for initiating, notification, or other command control functions required for complete system operation:
 - a. Individual floor or building plan view drawings indicating device locations including end of line resistors "EOLR" in accordance with the legend provided.
 - b. Individual point addresses for initiation and notification devices.

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- c. Device “typical” wiring diagrams. These drawings shall indicate specific termination details for peripheral equipment and interface devices.
 6. Provide interfacing with equipment furnished by others including voltages, and other required coordination items. Refer to 3.01-B.
 7. Each of the pictorial diagrams included shall appear identical to the products they are intended to depict, in order to speed installation of the system, and to enhance the accuracy of the installation Work. Typical wiring diagrams or catalog sheets are not permitted.
 8. Background Drawings with device locations of DSA approved drawings are available in electronic format and may be obtained from the Owner Authorized Representative (OAR). Contractor is solely responsible for the accuracy and completeness of shop drawings. Buildings that are not part of the contract shall be clearly identified “NOT IN CONTRACT”. Shop Drawings shall be prepared in the latest version of AutoCAD with three – CD ROM electronic copies submitted along with full sized Shop Drawings.
 9. Other installation and coordination drawings specifically related to this section shall be included as follows:
 - a. Size A (8 ½ by 11) and size B (11 by 17) shall be bound into the manual.
 - b. Larger drawings shall be folded and inserted into transparent envelopes and bound into the manual.
 10. Installation and coordination drawings for items in other sections shall be included with submittal of Shop Drawings. Submit blue line copies and one reproducible copy of installation and coordination drawings.
 11. Samples: Provide Samples of material and equipment as required by the Architect. If Samples are requested, they shall be submitted within ten days from date of request.
- D. In addition to the above requirements, provide submittals to meet any additional requirements of DSA.
- E. Submittal of Equivalent Systems:
 1. In addition to the submittal requirements of this section, if an equivalent system listed in Section 2.01A is submitted in lieu of the designed system shown on DSA approved drawings, the Contractor shall also submit a letter stating that the system is equivalent, and that device locations and quantities of devices are unchanged. Attached to this letter shall be a copy of the revised equipment schedule with corresponding CSFM numbers and a cut sheet for each item.
- F. Modifications or additions to existing fire alarm systems shall be compatible and of the same manufacturer as the existing system. Contractor shall be solely

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responsible for engineering, plan check and any fees resulting from an installation that deviates from this requirement.

- G. Prior to Substantial Completion submit to the Architect or Engineer of Record and to Owner Authorized Representative a complete updated set of the Shop Drawings showing changes made to the Fire Alarm System during construction. These drawings will become the System As-Built Drawing set for the Fire Alarm System Owner's Manual.

1.08 QUALITY ASSURANCE

- A. Installer shall have successfully completed at least five projects of equal scope in the past five years, and have been in business of furnishing and installing fire alarm systems of this type for at least five years.
- B. Installer shall be a factory authorized distributor and service provider for the brand of equipment offered and shall provide documentation to the Architect upon request.
- C. Installer shall maintain a fully equipped service organization capable of furnishing repair service to the equipment and shall maintain a spare set of major parts for the system at all times.
- D. Installer shall furnish a letter from manufacturer of equipment certifying equipment has been installed according to factory standards and that system is operating properly.
- E. Certifications: Installer shall submit certification from the equipment manufacturer indicating that installer is an authorized representative of the equipment manufacturer and is trained on network applications.
- F. Materials and equipment installed shall be new.
- G. Equipment in this specification shall be furnished and installed by the Authorized Factory Distributor of the equipment. Furnish a letter from the manufacturer of major equipment, which certifies that the installer is an authorized distributor and that the equipment has been installed according to factory intended practices. Furnish a written guarantee from the manufacturer that they will have a service representative assigned to this area for the life of the equipment.
- H. Installer shall be Underwriters Laboratory (UL) listed company under the UUJS classification, and shall certify that the installation has been made in accordance with UL requirements.
- I. The fire alarm contractor shall have a NICET II Certified Technician on staff in their facility directly involved with this project to ensure technical expertise to this project and adherence with these specifications.
- J. Contractor or Installer's Electricians and fire and life safety technicians shall be certified in accordance with Labor Code sections 3099, and 3099.2, and section 209.0 of the California Code of Regulations.

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- K. System startup and testing shall be performed under the direct observation of the Project Inspector and OAR. Provide a legible half size reproduction of the original completed fire alarm red-line drawings (this copy will be retained by the Owner), an accurate copy of the fire alarm system points list, and a copy of the construction drawings on CD in AutoCad format.
- L. At the time of installation the most current software package available shall be provided.
- M. Provide at the time of Owner Acceptance of the installation, equipment, and updated software which is to include the appropriate operating system, pass-codes, electronic keys and program disks, manuals and cables employed in the installation of the system. These components shall be delivered to the OAR.
- N. Provide a backup copy of the most current software revision, in disk format. This copy shall be delivered to the OAR
- O. A software license agreement shall be made available for the responsible Owner representative to sign at the time of training.

1.09 WARRANTY

- A. The Fire Alarm Equipment Manufacturer shall provide a three year material warranty. Installer shall provide a three year labor warranty.
- B. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer for a period of five years after expiration of the warranty.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Fire alarm equipment shall be standard products of the Silent Knight, to match existing campus system.
- B. Catalog and model numbers listed are intended to establish type and quality of equipment and system design as well as operating features required. Deviations from intended functions of specified system are not permitted. Equipment shall not be ordered or installed until such equipment has been reviewed and approved by the Architect.
- C. Products requirements indicated in articles 2.02 through 2.05 are based on Notifier system components. Refer to Attachment A – Fire Alarm Approved System Components for a complete list of approved products.

2.02 FIRE ALARM CONTROL PANEL (FACP) OR NETWORK NODES

- A. Furnish Fire Alarm Control Panels as indicated on drawings.
- B. Operator Control:

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1. Acknowledge Switch: Activation of control panel acknowledge switch in response to a single new trouble or alarm condition shall silence panel sounding device and change system alarm or trouble LED from flashing to steady-ON. If additional new alarm or trouble conditions exist in system, activation of this switch shall advance display to next alarm or trouble condition that exists, and shall not silence local audible device or change LED to steady until new conditions have been so acknowledged. New alarm conditions shall always be displayed before new trouble conditions. Occurrence of a new alarm or trouble condition shall cause panel to resound, and sequences as described above, shall repeat.
 2. Signal (Alarm) Silence Switch: Activation of the signal silence switch shall cause programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully fielded programmable within the confines of applicable standards at the job site. The FACP software shall include silence inhibit and auto-silence timers.
 3. Alarm Activate (Drill) Switch: Alarm activate switch shall activate notification appliance circuits. The drill function shall latch until the panel is silenced or reset.
 4. System Reset Switch: Activation of the System Reset switch shall cause electronically-latched initiating devices, appliances or software zone, as well as associated output devices and circuits, to return to their normal condition.
 5. Lamp Test Switch: Switch shall activate local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personnel.
 6. Hot Button Switch: Hot Button Key switch shall be provided in FACP to disable all output devices for testing or repair of system. Key switch shall silence all horn and strobes, disable PA cutouts, HVAC shutdowns, door closures, and Autonomous PA systems. Key switch shall be password protected to enable function. LED indicator shall illuminate a trouble condition while Hot Button Switch is activated and shall turn off when system is re-enabled.
- C. System Capacity and General Operation
1. The control panel or each network node shall provide or be capable of expansion to 636 minimum intelligent addressable devices in smaller systems, and 3180 intelligent addressable devices for larger systems.
 2. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of two amps at 30 VDC. It shall also include four Class B (NFPA Style Y) or Class A (NFPA Style Z) programmable Notifications Appliance Circuits.
 3. The control panel or each network node shall support up to eight output modules (signal or relay), each with eight circuits for a total of 64 circuits

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for the smaller capacity panels, and 12 output modules for a total of 96 circuits for the larger capacity panels. Programmable notification appliance circuits shall be class B.

4. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system status LEDs, and an alphanumeric keypad with easy touch rubber keys for the field programming and control of the fire alarm system.
5. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
6. The system shall allow the programming of any input to activate any output or group of outputs. The FACP shall support up to 20 logic equations, including "and" "or" and "not", or timed delay equations to be used for advanced programming. Logic equations shall require the use of a PC with software utility designed for programming.
7. The FACP or each network node shall provide the following features:
 - a. Drift compensation to extend detector accuracy over life. Drift Compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
 - b. Detector Sensitivity tests, meeting requirements of NFPA 72 Chapter seven.
 - c. Maintenance alert, with two levels (maintenance alert or maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
 - d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be 0.5 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot for ionization detectors. The system shall also support sensitive advance detection laser detectors with an alarm level range of 0.03 percent per foot to one percent per foot. The system shall also include up to nine levels of Pre- alarm, selected by detector, to indicate impending alarms to maintenance personnel.
 - e. Circuit boards, programming, and interconnecting cables to enable the system to display or print system reports.
 - f. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.
 - g. PAS pre-signal testing in accordance with California Fire Code (CFC) and NFPA 72 requirements.

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- h. Rapid manual station reporting (less than three seconds) shall meet CFC and NFPA 72 requirements for activation of notification circuits within ten Seconds of initiating device activation.
 - i. Periodic detector test, conducted automatically by the software.
 - j. Self-optimizing pre-alarm for advance fire warning, which allows each detector to learn its particular environment and set its pre-alarm level to just above normal peaks.
 - k. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
 - l. Walk test, with a check for two detectors set to same address.
 - m. Control-by-time for non-fire operations, with holiday schedules.
 - n. Day or night automatic adjustment of detector sensitivity.
 - o. RS 232 serial port to support a District supplied printer to be used for silent testing and certification of the system.
8. The FACP shall be capable of coding main panel(s) node notification circuits in temporal code (NFPA 72 A-2-2.2.2). The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific "sync pulse".
9. Network Communication:
- a. The network architecture shall be based on a Local Area Network (LAN), a firmware package that utilizes a peer-to-peer, inherently regenerative communication format and protocol. The protocol shall be based on ARCNET or equivalent non-proprietary protocol.
 - b. Failure of any node shall not cause failure or communication degradation of any other node or change the network communication protocol among surviving nodes located within distance limitations. A node may be an intelligent Fire Alarm Control Panel (FACP), Network Control Station PC (NCS) or Network Control Annunciator (NCA).
 - c. Each network node address shall be capable of storing Event Equations which shall be used to activate outputs on one network node from inputs on other network nodes.
- D. System Display:
- 1. Utilize the 640-character display option. The design of the CPU shall provide for a configuration with the 640-character display mounted on the front of the unit in place of the standard 80-character display.
 - 2. The 640-character display shall provide the controls and indicators used by the system operator: The 640 character display shall include the following

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operator control switches; Acknowledge, Alarm, Silence, Alarm Activate (drill), System Reset and Lamp Test.

3. The display shall annunciate status information and custom alphanumeric labels for intelligent detector, addressable modules, internal panel circuits, and software zones.
 4. The 640-character display shall provide ten Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC Power and Network Communication, Fire Alarm, Pre alarm Warning, Security Alarm, Supervisory Event, System Trouble, Alarm Silence, Disabled Points, CPU failure.
 5. The 640-character display shall use ten "soft" keys for screen navigation or to accomplish dedicated programming functions. Full programming access shall require use of a laptop and the proper programming utility. The programming utility shall be provided to the OAR who will forward it to the local maintenance area representative.
 6. The system shall support the display of battery charging current and voltage on the LCD display.
- E. Network Control Annunciator:
1. When a networked system is installed a network controlled annunciator (NCA) shall be provided to display system intelligent points. The NCA shall be capable of displaying information for all possible points on the network.
 2. The NCA shall include a minimum of 640 characters, backlit by a long life, solid-state LCD display. Additionally, the network display shall include ten soft keys for screen navigation and the ability to scroll events by type. i.e. Fire Alarm, Supervisory Alarm, Trouble, etc.
 3. The NCA shall have the ability to display up to eight events in order of priority and time of occurrence. Counters shall be provided to indicate the total number of event by type.
 4. The NCA shall mount in a Notifier ABS-2DB or equal keyed box; provide a key enable or disable switch for the network node fire alarm control panels. The network display may mount in a backbox designed for this use. The network shall support the NCAs.
 5. The network control annunciator shall have an event history buffer capable of storing a minimum of 1000 events in nonvolatile memory. Additionally, the NCA shall have a fire alarm history buffer capable of storing a minimum of 200 events in nonvolatile memory.
 6. The NCA shall include two EIA-232 ports for UL864 listed printers and CRT's.
 7. The NCA shall include control switches for system wide control of Acknowledge, Signal Silence, System Reset, Drill, and local Lamp Test. A

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mechanical means, by which the controls switches are locked out, such as a key, shall be provided.

8. The NCA shall include long life LEDs to display Power, Fire Alarm, Pre-Alarm, Security Alarm, System Trouble, Supervisory, Signals, Silenced, Disabled Prints, other (non-fire) Events, and CPU Failure.
9. The NCA shall include a Master Password and up to nine user Passwords. The Master password shall be required to access the programming and alter status menus. Each User password may have different levels of authorization assigned by the Master password. Passwords installed into the NCA shall be made available to the OAR who will forward them to the local maintenance area representative.
10. The NCA shall allow editing of label for points within the network, control on or off of outputs, enable or disable of network points, alter detector sensitivity, clear detector verification counters for any analog addressable detector within the network, clear any history log within the network, change the Time or Date settings, initiate a Walk Test.
11. The NCA shall include a time of day clock.
12. Each NCA shall support 80-character remote display annunciators for displaying network activity. These "Terminal Mode" displays will mimic the activity appearing on the corresponding NCA. There shall be only one annunciator or control system consisting of components manufactured by one manufacturer for the fire alarm system.

F. Signaling Line Circuits (SLC):

1. Each FACP or FACP network node shall support a minimum of one SLC for the smaller panels and ten SLC's for the larger panels. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photoelectric or thermal) and 159 intelligent modules (monitor or control) for a loop capacity of 318 devices.
2. CPU shall receive analog information from intelligent detectors to be processed to determine whether normal, alarm, pre-alarm, or trouble conditions exist for each detector. The software shall 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 shall also be used for automatic detectors testing and for the automatic determination of detector maintenance requirements.

G. Enclosures:

1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be constructed of 0.030 steel with provisions for electrical conduit connections into the sides and top.

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3. The supplied door shall include a key lock and shall include glass or other transparent opening for viewing of indicators. For convenience, the door may be site configured for either right or left hand hinging.

H. Power Supply:

1. An off-line switching power supply shall be available for the fire alarm control panel or network nodes.
2. Provisions shall be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
3. Over-current protection shall be provided on power outputs. The power supply shall provide an integral battery charger. Battery arrangement may be configured in the field.
4. The power supply shall continuously monitor field wires for earth ground conditions, and shall have the following LED indicators:
 - a. Ground Fault LED.
 - b. AC Power Fail LED.
 - c. NCA-2 on LED (4).
5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide power for the FACP or network node(s).
6. The main power supply shall provide a battery charger using dual rate charging technology for fast battery recharge and be capable of charging batteries up to 60 AH for the smaller panels and 200 AH for larger panels.

2.03 REMOTE ANNUNCIATORS

- A. A non-networked fire alarm system annunciator is required when there is only one FACP in the system. Provide alphanumeric display remote annunciator(s) per plans. A Network annunciator is required for any system that contains more than one fire alarm control panel (FACP) or network node. Display shall be back lit and be furnished with a maximum of 20 characters of 4 lines for the smaller panels, and 40 characters on 16 lines for the larger panels. Annunciators shall provide the following functions:
1. Control switches for system acknowledge, signal silence and system reset via a touchpad.
 2. Time and date display field.
 3. Local piezo sounder with alarm or trouble resound.
 4. On-line green LED (flashing).
 5. Evacuation and drill switches, via a touchpad.
 6. Pre-signal hold via a touchpad.
 7. System test at control panel and CTR.

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- B. Following additional features shall be furnished:
 - 1. Device Fire Annunciation.
 - 2. Device Trouble Annunciation.
 - 3. System Operation Annunciation.
 - 4. "Power On" LED.
- C. Typewritten operating instructions and a site map shall be posted adjacent to remote annunciator(s). The site map shall be sized and include designations and devices as described in paragraph 3.02 N. of this specification. Project site map shall depict fire alarm devices in the building(s) in which they are installed. The instruction and site map shall be mounted in suitable document frames and attached to the wall with a minimum of two screws each. Contractor's name and telephone number shall not be placed on either the instruction or the site map.

2.04 POWER SUPPLIES

- A. Remote Notification Appliance Circuit (NAC) extender power supplies shall be furnished with main printed circuit board, transformers, lockable cabinet, and batteries. Unit shall be configured to drive 4 notification appliance circuits. The remote power supplies shall be configured with a monitor module to report trouble conditions to the controlling FACP via an SLC. Triggering of NAC inputs shall be directly controlled from the FACP without the use of addressable control or relay modules.

2.05 PERIPHERAL DEVICES AND EQUIPMENT

- A. Manual Stations (interior): Manual pull stations shall be addressable semi-flush, non-breakable glass type for building interiors. Station housing shall be fabricated of die-cast aluminum with reset lock and key. Provide an addressable monitor module for each manual station.
- B. Manual Stations (exterior): Manual stations shall be addressable semi-flush, non-breakable glass type for building exteriors. Station housing shall be fabricated of die-cast aluminum with reset lock and key. Provide an addressable monitor module for each manual station.
- C. Smoke Detectors: Smoke Detectors shall be addressable. Detector shall be microprocessor based, using a combination of photoelectric, and thermal sensing technologies. The smoke detector shall have its loop number and electronic address permanently and clearly labeled onto the device base using a p-touch type labeling system. The label shall be visible without removing the detector head.
- D. Non-Explosion Proof Automatic Addressable Heat Detectors shall be combination rate-of-rise and fixed-temperature type. When fixed-temperature portion is activated, units shall provide visual evidence of such operation (LED). The location of the heat detector must be clearly marked below the ceiling and the detector must be readily accessible. The heat detector shall have its electronic address permanently and clearly labeled onto the device and be readily accessible. For

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spaces such as attics, where the ambient temperature can reach around 150° degrees Fahrenheit in hot days, use detectors rated for the application. The heat detector shall have its loop number and electronic address permanently and clearly labeled onto the device using a p-touch labeling system. The label shall be visible without removing the detector head.

- E. Weatherproof Automatic heat Detectors: shall be rated for 135° degree Fahrenheit alarm temperature. Detector shall be mounted horizontally in a two gang weatherproof box with cover manufactured by Hubbell/Bell or equivalent from other owner approved manufactures. Install an appropriate wire protective cover over box and detector. Conduit type and fittings shall be suitable for the environment where the device will be installed.
- F. Projected Beam Infrared Type Smoke Detectors shall consist of a transmitter/receiver unit and reflector to be used in accordance with manufacturer's recommendations. Each detector shall include six user-selectable sensitivity levels. Alignment shall be achieved with a signal strength meter incorporated into the beam detector. The detector shall feature automatic detection and adjustment to the optimum level for the specific environment. Provide remote Notifier Model RTS-451KEY test stations with key lock for detectors or equal, locate test stations below ceiling.
 - a.
- G. Multi-Criteria Fire Detectors (MS and HS Only): These Detectors shall be used on performing stages and surrounding areas of the performing stage and other locations where the use of special effect smoke systems may be used.
 - 1. Multi-Criteria Fire Detector shall combine four separate sensing elements into one unit:
 - a. Photoelectric chamber shall sense airborne particulate for smoke detection.
 - b. Electrochemical cell technology shall monitor carbon monoxide.
 - c. Infrared sensing shall measure ambient light levels and flame signatures.
 - d. Thermal detection shall monitor temperature.
 - 2. Multi-Criteria Detector shall be capable of generating only one alarm signal from at least two sensors of the four when positively confirming a fire. The sensor output shall be mathematically evaluated to determine when a signal is warranted.
 - 3. Twin LED indicators shall provide 360 degree visibility.
- H. Monitor Modules:
 - 1. Monitor modules shall connect a supervised zone of conventional initiating devices, N.O. dry contact devices, including four-wire smoke detectors, to one of SLC loops. Monitor module shall install in a four-inch square by 2 1/8-inch deep electrical box. The module shall have its loop number,

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electronic address, and function label on the front cover using a P-Touch type or equal labeling system.

2. Monitor module shall provide address-setting means using rotary decimal switches and shall store an internal type of device. An LED shall be provided which shall flash under normal conditions indicating that monitor module is operational and in regular communication with control panel.

I. Control Modules:

1. Control modules shall be used to connect conventional indicating appliances or MR type isolation relays to one of the SLC loops. Control modules shall be installed in a standard four-inch square by 2 1/8-inch deep electrical box. Audio or visual or relay power shall be provided by a separate loop from main control panel or from supervised remote power supplies. Each module shall have its loop number, electronic address, and function label on the front cover using a p-Touch type or equal labeling system. Provide Air Products PAM-3 Relay Model or equal power supervision relay to monitor 24-volt DC power.
2. Control module shall provide address-setting means using rotary decimal switches and shall store an internal identifying code which control panel shall use to identify type of device. An LED shall be provided which shall flash under normal conditions, indicating that control module is operational and in regular communication with control panel.

J. Relay Modules:

1. Relay Module shall be Silent Knight SK-RELAY depending on requirements. Modules shall provide as a minimum one set of form "C" dry contacts and have its loop number, electronic address, and function labeled on the front cover using a P-Touch type labeling system.
2. Provide a buffer relay that is part of the control system if controlled circuit(s) exceeds the voltage or current rating of the relay module.
3. Relays used to interface control of other systems shall be electrically supervised and shall only be wired in a fail-safe mode of function during a power failure.

K. Isolator Modules:

1. Isolator module shall isolate wire-to-wire circuits on an SLC loop in order to limit number of other modules or detectors that are incapacitated by short circuit fault. If a wire-to-wire short occurs, isolator shall automatically open-circuit SLC loop. When short is corrected, isolators shall automatically reconnect isolated section of SLC loop.
2. Isolator module shall not require address setting, although isolators will electrically reduce capacity of loop by two detectors or module addresses. Isolator module will install in a standard 4-inch deep electrical box. It shall include a single LED that shall flash to indicate that isolator is operational

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and shall illuminate steadily to indicate that a short has been detected and isolated.

- L. Horns and Strobes: Horns and strobes shall be products of the same manufacturer. In order to establish a standard of quality, items are specified from the products manufactured by System Sensor, acceptable manufacturers are Honeywell, Wheelock Inc., Gentex or District approved equal. Addressable or multifunction two wire indicating (Audible or Visual) appliances shall not be acceptable.
1. Alarm horns shall be polarized and operated by 24 VDC. Entire unit shall be red finish. Horn assemblies shall be furnished with separate wire leads for in or out wiring for legs of associated signal circuits. Tapping of signal device conductors to signal circuit conductors is not permitted. Suitable gaskets shall be provided for weatherproof installation. Horns shall provide a minimum sound pressure level of 100 dB at 10 feet. Horns shall be mounted on manufacturer's recommended outlet boxes. Provide horns with a back box skirt on indoor surface mount outlet boxes.
 2. Horn/strobe shall be wall mounted or ceiling mounted System Sensor or equal. Horn/strobe shall operate on two separate two wire 24 VDC polarized circuits and shall be provided with a semi-flush mounting plate. Entire unit shall be red finish. Strobe light shall have a clear Lexan lens. The word "FIRE" shall be printed on the two sides of the strobe body. Horn shall provide a minimum sound output of 100 dB at 10 feet. The strobe shall provide a selectable minimum light intensity of 15, 30, 60, 75, 90, 110, 135, 150, or 185 Candela as indicated on Drawings to meet or exceed requirements of CBC, CHAPTER 11B AND ADAAG and UL 1971. Horn/Strobes shall be mounted on manufacturer recommended outlet boxes. Weather proof horn or strobe shall be model No. P4RK or Model No. P4RHK. Provide a model No. BBS-2 back box skirt on indoor surface mounted outlet boxes.
 3. Strobe indicating appliances shall be System Sensor or equal. Devices shall be UL listed and shall be wall-mounted. Entire unit shall be red finish. Strobe light shall have a clear Lexan lens. The word "FIRE" shall be printed on two sides of the strobe body. Strobes shall meet CBC, CHAPTER 11B AND ADAAG and UL 1971 requirements. The strobe shall provide a selectable minimum light intensity of 15, 30, 60, 75, 90, 110, 135, 150, or 185 Candela as indicated on the Drawings to meet or exceed requirements of CBC, CHAPTER 11B AND ADAAG and UL 1971. Strobes shall be mounted on manufacturer recommended outlet boxes. Weather proof strobe shall be model No. SRK or Model No. SRHK. Provide a model No. BBS-2 back box skirt on indoor outlet boxes.
 4. Strobe synchronization modules if required shall be System Sensor or equal, to be installed in conjunction with two or more strobes located in same room or corridor or as indicated on Drawings. (Strobe synchronization modules must be compatible with installed strobes).

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- M. Electromagnetic Door Holder: Electromagnetic door holders shall be installed on doors as indicated on Drawings or as required. Electromagnetic Doors shall consist of a wall-mounted electromagnet and a door-mounted armature with an adjustable contact plate. Electromagnets shall provide a force of attraction of 35 pounds when energized and less than three pounds residual with power disconnected. Armature contact plates shall provide a horizontal adjustment of 25 degrees. The holding force of Electromagnetic Doors shall be totally electromagnetic and without the use of mechanical linkage or other moving parts. Electromagnetic Door Holders shall normally be energized, and a release shall be accomplished by interrupting the circuit. Door holders shall be Reliable Security Group DH Serie or Altronix. The power supply shall be equipped with a failsafe input trigger circuit and five individually protected outputs. (Electromagnetic Door holders shall not be powered by an FACP or remote NAC power supplies).
- N. Bells shall be System Sensor polarized type and operated by 24 VDC. Bell shall be powered from FACP or Remote NAC power supply. When used as a notification appliance to indicate fire sprinkler water flow the bell shall be directly controlled by contacts in the associated flow switch. Addressable relays or control modules shall not be used to supervise sprinkler bells. Bell assemblies shall provide separate wire leads for in or out wiring for legs of associated signal circuits. Bells shall be vibrating type providing a minimum sound pressure level output of 84 - 87 dB at ten feet. Bells shall be ten inches in diameter, finished with baked-on red enamel paint, UL listed for fire alarm installation, and suitable for surface or semi-flush mounting. Provide a sign adjacent to the water flow bell with one inch tall and 3/8 inch stroke white lettering on a bright red background. The sign shall read: "NOTIFY FIRE DEPARTMENT WHEN ALARM SOUNDS".
- O. Water-flow Switches:
1. Water-flow switches shall be Potter Electric or equal. Vane-type water-flow switches shall be installed on system piping as designated on Drawings or as required. Detectors shall install on clear pipe spans of appropriate nominal size, either a vertical or horizontal run, at least six inches from fittings or valves which may change water direction, flow rate or pipe diameter, and not closer than 24 inches to valves or drains. Detector shall respond to water-flow in specified direction after a preset time delay that is field adjustable. Actuation mechanism shall include a polyethylene vane inserted through a hole in the pipe and connected by a mechanical linkage to delay mechanism. Output shall consist of ten amps (dual SPDT switches form-C contacts). A conduit entrance for standard electrical conduit fittings shall be provided on detectors. Detectors shall be listed by UL for indoor or outdoor installation. No more than 18 inches of seal-tight flex may be used to connect the water flow or tamper switch to the site conduit system at any one location.
 2. Sprinkler valve tamper switches shall be System Sensor for use with outside screw-and-yoke valves or for use with post indicating valves or equal, as indicated. Supervisory switch shall be installed on valves as designated on Drawings or as required. Switches shall be installed to not

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interfere with normal valve operation and shall be adjusted to operate within two revolutions of valve control or when stem has moved no more than 1/5 of distance from its normal position. Mechanism shall be housed in a weatherproof die cast metal enclosure, also providing a 3/4 inch tapped conduit entrance to incorporate necessary facilities for attachment to valve. Switch mechanism shall be furnished with a minimum rated capacity of ten amps at 125 VAC and 2.5 amps at 24 VAC. Entire installed assembly shall be tamper-resistant. Tamper switches shall be UL listed. No more than 18 inches of seal-tight flex may be used to connect the water flow or tamper switch to the site conduit system at any one location.

- P. Universal Digital Alarm Communicator Transmitter (UDACT) is an interface for communication of digital information between a fire alarm control panel and a UL-Listed central station.
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 6000 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.
 2. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL or NFPA or FCC requirements. It shall include the ability for split reporting of panel events between up to three different telephone numbers.
 3. It shall be completely field programmable from a built in keypad or laptop computer, and shall be capable of transmitting events in multiple formats.
 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) and Earth Fault.
 - d. System Off Normal.
 - e. 12 and 24 Hour Test Signal.
 - f. Abnormal Test Signal (per UL requirements).
 - g. EIA-485 Communications Failure.
 - h. Phone Line Failure.
 5. The UDACT shall support independent zone or point reporting when used in the Contact ID format. This enables the central station to have exact details concerning the origin of the fire or response emergency.
 6. The UDACT shall be supplied with two eight conductor, two to six foot long line cords. One end of the cords shall plug into the jacks on the UDACT. The other end of the cords shall plug into industry standard RJ-31X surface

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mounted telephone jacks. Install jacks in a screw cover box adjacent to the FACP if sufficient space is not available within the FACP, or adjacent fire alarm terminal cabinet. The line cords shall be installed in conduit when it is necessary to locate the jacks remotely from the FACP enclosure. The jacks shall be mounted to the rear of the box. The telephone number for each line shall be labeled on its respective jack.

Q. Voice Evacuation System:

1. The Voice Evacuation Control (EVAC) Panel. The self-contained control panel shall be equipped with dual 25-watt audio amplifiers each with a single style Y (Class B) supervised 25 Vrms output circuit. The EVAC panel shall have the ability to record a minimum of two field-programmable messages of up to 60 seconds total duration with an integral microphone or an external source via an audio input jack. The messages shall be stored digitally onto a non-volatile EEPROM. The message(s) shall be individually field programmable for three, four, six, eight, or indefinite repeat while triggered by the host FACP. Any message being delivered at the time of the trigger circuit(s) reset shall not stop in mid-sentence but shall be completed to the end of the message. A tone generator shall be provided capable of emulating a field programmable lead-in or trailing alert tone or an Audible Emergency Evacuation Signal (Temporal Pattern). The EVAC panel shall be capable of electrically supervising in both active and standby conditions, the amplifier outputs, field wiring, message generator, tone generator, microphone and primary or secondary power supplies to an internal trouble relay(s). The trouble relay(s) contacts shall be accessible via a terminal strip and be configured and connected to report internal or external trouble conditions to the host FACP via the trigger circuit or a separate monitor module. The minimum of two trigger circuits shall be individually field-configurable for triggering with a NAC circuit or a supervised dry contact. The control panel shall be equipped with LED indicator lights for Power On, System Trouble, Message Generator Trouble, Tone Generator Trouble, Microphone Trouble, Battery Trouble, Charger Trouble, Ground Fault, Output Circuit Trouble and Amplifier Supervisory. The panel shall be equipped with an internal monitor speaker for reviewing the field recorded messages. The primary power supply shall operate at 120 VAC through a dedicated 20 amp. circuit and shall be capable of charging 18 AH lead acid batteries. Provide two 12 volt batteries that will provide a secondary power source for the same or longer duration than is required by the host FACP. An auxiliary 24 volt DC power output shall be provided for use by an associated addressable control module. The EVAC control panel shall be triggered either directly by the associated FACP with a NAC circuit or by an addressable control module. Provide 3/8 inch minimum P Touch labeling on the window in front of the built in microphone indicating that "THE INTERNAL MICROPHONE IS TO BE USED FOR THE RECORDING OF ANNOUNCEMENTS ONLY. NOT FOR USE BY STAFF OR FIRE DEPARTMENT PERSONNEL."

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2. Ceiling Mounted eight-inch EVAC Speakers shall be System Sensor. The speaker assembly shall be supplied with a white 12 inch round metal grill. The 8 inch speaker shall have an impedance of 8 ohms, minimum 9.5 ounce magnet and an attached 25 volt audio line matching transformer with 1/8, 1/4, 1/2, 1, 2, 4 and 8 watt tap settings and DC blocking capacitor. Wattage shall be selectable by the use of a jumper or shunt. Audio levels shall be 75, 78, 81 87, 90 or 93 dba at ten feet. Input or output terminals that will accommodate 12 to 18 AWG wire shall be provided. Speakers orientated in the same direction shall be connected in phase with each other. Multiple speakers in areas such as Auditoriums or Gymnasiums shall be divided into two circuits in a checker board pattern and connected separately to the two audio output circuits.
 3. Wall Mount four-inch EVAC Speakers shall be mounted on a manufacture recommended outlet box. When mounted on a surface mount outlet box, Provide a Model No. BBS-SP201R surface mount backbox skirt. The speaker assembly shall be supplied with a square high impact red grill. The four inch speaker shall have an attached 25 volt audio line matching transformer with 1/4, 1/2, 1 and 2 watt tap settings and a DC blocking capacitor. Wattage shall be selectable by the use of a jumper or shunt. Audio levels shall be 80, 84, 86 or 89 dba at ten feet. Input or Output terminals that will accommodate 12 to 18 AWG wire shall be provided. Speakers orientated in the same direction shall be connected in phase with each other; but when installed facing opposite directions they shall be connected out of phase.
- R. Network Cables or SLC or Annunciator Data or Audio Output Cables: The construction and physical characteristics such as aqua-seal water block, wire gage, insulation and jacket types, etc. shall not be altered. Equivalent cables must be specifically approved and recommended by the manufacturer of the fire alarm system equipment. Substitutions will require review from the Architect or Engineer of Record.
- S. The cable types listed below are based and specified on the recommendations of Notifier Fire Alarm Systems. If the submitted fire alarm system requires a different cable configuration with additional conductors, multi-conductor versus twisted pairs, etcetera, other than as is specified above, then request a substitution to supply and install the configuration of cables by the make and model of the fire alarm system that is to be installed.
1. Indoor Network and EVAC System Audio Output Circuit(s) applications shall be in conduit or in surface mounted raceway as indicated on drawings: West Penn No. D980, one pair 18 gage solid copper, unshielded, Copolene II insulated and PVC jacketed, or equal.
 2. Indoor SLC applications in conduit or in surface mounted raceway where it is indicated on drawings: West Penn No. D990, one pair 16 gage solid copper, unshielded, Copolene II insulated and PVC jacketed, or equal.

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3. Indoor Annunciator applications in conduit or in surface mounted raceway where it is indicated on drawings: West Penn No. D975, one pair 18 gage solid copper, shielded, Copolene II insulated and PVC jacketed, or equal.
 4. Outdoor or Underground Network Applications: West Penn AQ224, two-conductor 18 gage stranded copper, unshielded, water-blocked construction and PVC insulated, or equal.
 5. Outdoor or Underground SLC applications: West Penn AQ225, 2-conductor 16 gage, AQ226, 2 conductor 14 gage, or AQ227, 2 conductor 12 gage stranded copper, unshielded water-blocked construction and PVC insulated, or equal.
 6. Outdoor or Underground Annunciator applications: West Penn AQ293, 2 conductors, 18 gage stranded copper, shielded water-blocked construction and PVC insulated, or equal.
- T. Protective Covers
1. Provide protective covers for pull stations, smoke and heat detectors, and audible and visual devices located in areas occupied by students that can be subjected to vandalism such as gyms, restrooms, locker and shower rooms, and all hallways and corridors associated with these spaces. Installation of cover must not protrude over current ADA limitations.

PART 3 - EXECUTION

3.01 GENERAL

- A. Fire alarm system shall not be used for any purpose other than fire alarm functions.
- B. Fire alarm shall be interconnected but not limited to the following systems:
 1. Systems required by code to be connected to the fire alarm systems shall be connected.
 2. Public address system for disabling the manual and automatic bell or tone class passing signals. Manual and automatic class passing signals shall not be operable during alarm conditions.
 3. Ventilation systems where required for the purpose of fan shutdown
 4. Damper control or smoke management systems.
 5. Water based fire sprinkler systems.
 6. Chemical fire extinguisher systems.
 7. Central and Autonomous PA system(s).
 8. Theatrical lighting control system.
- C. Fire alarm system shall not be interconnected to any of the following:
 1. Sump warning systems,

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2. Carbon monoxide detection systems.
3. Other unrelated system.

3.02 SYSTEM INSTALLATION

- A. Install required conductors to devices indicated on Drawings. Provide required conductor terminations to devices for a complete system to function as specified and indicated on Drawings. Refer to Section 26 05 19: Low-Voltage Wire (600 Volt AC), for installation and color coding requirements.
- B. Splices are not allowed in junction boxes. Terminations shall be in terminal cabinets or on equipment terminals.
- C. Conductors shall be installed within conduits, boxes, and terminal cabinets in a totally enclosed installation. Furnish and install conductors required to connect incoming and outgoing circuits, including spare conductors, to terminal strips within terminal cabinets.
- D. Wiring within equipment and terminal cabinets shall be installed to conform to contract documentation and NFPA 72 standards, and shall be terminated on terminal blocks having terminals for required connections. Wiring shall be cabled, laced, and securely fastened in place so that no weight is imposed on equipment or terminals.
- E. Install required terminal blocks within terminal cabinets. Terminal blocks shall be installed on inside back of cabinets only, not on side. Incoming wiring shall be terminated on the left side of terminal blocks; outgoing wiring shall be terminated on the right side of the terminal blocks.
- F. Conductors shall be color-coded per specification section 26 0519 Low Voltage wires and tagged with code markers at terminal cabinets, and equipment. A wire index shall be typed and installed on terminal cabinet doors. Index shall be covered with clear plastic adhesive covers. Wiring shall be identified as to building and location of devices in the index.
- G. Wiring within equipment and terminal cabinets shall be carefully strapped, and shall be formed in rectangular configuration. Wires shall be properly numbered in numerical order and shall maintain same number throughout the Project site.
- H. Complete installation shall comply with local building codes and applicable provisions of the California Electrical Code, California Fire Code and the NFPA 72 National Fire Alarm Code.
- I. Location of outlet boxes and equipment on Drawings is approximate, unless dimensions are indicated. Do not scale Drawings to determine locations and routing of conduits and outlet boxes. Location of outlet boxes and equipment shall conform to architectural features of the building and other Work already in place, and must be ascertained in the field before the start of Work.
- J. Drawings generally indicate Work to be provided, but do not indicate all bends, transitions or special fittings required to clear beams, girders or other Work already

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in place. Investigate conditions where conduits are to be installed, and furnish and install required fittings.

- K. Provide P-touch label of approximately one inch wide with red lettering for each initiating device that is hidden from view. Tags shall indicate the name and type of device: Heat Detector, or Duct Smoke Detector. Tags shall be permanently attached on access panel or t-bar grid which is used to access a hidden device.
- L. Provide adjacent to each annunciator a neatly typewritten copy of the Fire Alarm Operating Instructions. The instructions shall reflect the installed and programmed features of the system. Instructions that include information on non-installed or programmed features will not be acceptable. The instructions shall be placed into a suitably sized dark colored wood or metal frame with a glass document face cover. The frame shall be attached to the wall with a minimum of two screws into the wall material with appropriate anchors.
- M. Provide adjacent to each annunciator a neatly drawn site map showing rooms with designations and buildings with names as programmed into the system. This map shall be sized to allow (normal vision) reading of the designations, names etc. A map so reduced in size to the point of not being readable will not be acceptable. This map shall include symbols indicating the locations of installed fire sprinkler flow switches, riser shut off valves, post indicating valves and manual pull stations. Provide a symbol list on the map for the symbols used. The site map shall be placed into a suitably sized dark colored wood or metal frame with a glass document face cover. The frame shall be attached to the wall with a minimum of two screws into the wall material with the appropriate anchors.

3.03 SYSTEM PROGRAMMING

- A. Programming shall be performed in accordance with District requirements set forth in this section – the local authority having jurisdiction and applicable codes. If a conflict arises or a clarification is required, the contractor through the project's OAR shall contact the Districts Fire Life Systems Testing Group (FLSTG) for clarification
- B. As part of the 50 percent construction completion label devices and locations in the manner indicted in the attached guidelines on a separate copy of the shop drawings. Request a meeting with OAR, Project Inspector, and representative of FLSTG to review, finalize and obtain approval of the proposed device, equipment and location descriptors that will be programmed into the system. The District may at time of substantial completion request minor changes to program descriptors if needed to conform to site conditions.
- C. The following functions and features as required by the site or system configuration and installed peripheral equipment and systems shall be programmed into fire alarm systems. The definition of programming shall include but not be limited to the use of a built in keyboard, the use of a connected PC with the appropriate software, dip or rotary switches, wiring or installable or removable jumpers as required or provided in the fire alarm equipment.
 - 1. Signal Silence Switch Inhibit: The audible signal silence switch located on the remote fire alarm annunciator(s) or any fire alarm control panel(s) shall

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be programmed to not silence the audible or extinguish the visual alarm circuits during the first minute (60 seconds) of alarm activation. Activation of this switch shall silence only the audible signals. Enabling or disabling this feature shall be allowed only if approved by the local Fire Marshal and District's Supervising Electrical Engineer, and authorized District maintenance personnel. The activation feature shall be protected by a maintenance level password.

2. Fire Sprinkler Water Flow Audible Appliance: The fire sprinkler water flow appliance (bell) shall not require any programming but shall be directly controlled by a set of dry contacts within the associated sprinkler water flow switch(s). The 24 volt DC auxiliary power for the sprinkler water flow audible appliances shall be supplied by an FACP or a remote power supply. This audible appliance shall operate continuously during the detection of fire sprinkler water flow and shall not be coded in any manner nor silenced automatically by any FACP or manually by any user controls at any FACP or remote annunciator.
3. Fire Sprinkler Water Flow Switch: Fire sprinkler water flow switches shall be programmed in a manner that shall prevent the above Signal Silence Switch from silencing the audible coded signals or visual signals after the initiation of an alarm by a fire sprinkler flow switch.
4. Audible Notification Appliance Circuits: Audible notification appliance circuits shall be programmed to emulate the temporal code (ANSI S 3.41) from fire alarm audible appliances (horns). This coding shall originate and be controlled by a single coder residing within the FACP(s). The use of coders within remote power supplies either mounted adjacent to an FACP or at a remote location or directly by an audible notification appliance will not be permitted. Programmable audible notification appliances shall be configured to emulate a steady tone at approximately 1000 Hz. Audible notification appliance circuits shall be programmed to be silenced as described above. Notification appliance circuits throughout the site shall be activated by any alarm initiating device. Coded audible signals shall be controlled by a single synchronized FACP.
5. Visual Notification Appliance Circuits: Visual notification appliance circuits shall be programmed to provide steady non-coded power to the visual appliances (strobes). As required by code and the system configuration, a synchronization signal shall be superimposed onto the NAC by the FACP, a remote power supply or an add-on synchronization module. Visual notification appliance circuits shall be programmed to be extinguished as described above. Visual notification appliance circuits throughout the site shall be activated by any alarm initiating device.
6. System Reset Button: The system reset button located on FACPs and remote annunciators in addition to resetting the fire alarm system and silencing or extinguishing notification appliances except for the sprinkler water flow appliances shall be programmed to reset analog and addressable smoke detectors, duct detectors, beam detectors and relays,

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addressable control modules and addressable relay modules used to interface to other systems and equipment. Each installed system reset button shall be programmed to operate as a “single point of reset” for the complete system.

7. HVAC Shutdown: Relays and addressable relay modules used to interface to HVAC equipment dampers, and supply and exhaust fan motors shall be programmed to shut down this equipment only within the same building where the detection of smoke, heat, carbon monoxide or fire sprinkler water flow has taken place. Manual pull stations within any building shall not affect the operation of the HVAC equipment. These relays shall return to normal only after the system is reset.
8. Smoke Detector Maintenance Alert: Addressable smoke detectors shall be programmed with the capability of initiating a maintenance alert when any one detector becomes obscured by dust or any other contaminates at approximately 10 percent below the level of obstruction that would initiate an alarm.
9. Disabling Class Passing Signals: The relay or addressable relay module shall be programmed to disable the class passing signals during any alarm condition at the site. This relay or addressable module shall return to normal only after the system is reset.
10. Disabling Audio of a Public Address System: The relay or addressable relay module shall be programmed to mute the audio output of the associated public address system during any activation of an audible notification appliance circuit or a voice evacuation announcement. This or these relays shall automatically restore to normal upon the silencing of the audible NACs and the voice evacuation announcement.
11. Release of Electro-Magnetically Held Doors: The relay or addressable relay module shall be programmed to open or close the control circuit as needed of the 24 volt DC door holder power supply. This relay(s) shall operate during any alarm condition within the same building as the door holders. The contacts shall return to normal only after system reset.
12. Illumination of House Lighting: The relay or addressable relay module shall be programmed to turn on to full brilliance the house lighting of an Auditorium, MP Room, etc. during any alarm condition at the site. This relay or addressable module shall return to normal only after the system is reset.
13. UDACT: The FACP and the associated Universal Digital Alarm Communication Transmitter shall be programmed to transmit to the central monitoring station separate indications for General Alarm, Fire Sprinkler Water Flow Alarm, System Trouble and Supervisory Conditions. These indications shall be in addition to any indications initiated by the UDACT itself.
14. Voice Evacuation Panel: The NAC originating at, or the addressable control module controlled by the associated FACP that is controlling the EVAC

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panel shall be programmed to emulate the above paragraph "E" Audible Notification Appliance Circuits except that it shall be non-coded. Trouble conditions at the EVAC panel shall report back to the associated FACP via the controlling NAC or addressable control module or a separate addressable monitor module. Transformer taps at the EVAC speakers shall be selected to provide the proper balance of audio volume in larger and smaller areas. The message shall be programmed in a female voice in the English language as follows: A minimum of two but no more than three cycle sounding of an approximate 1000 Hz tone in the pattern of the NFPA required temporal code followed by: "May I have your attention please. May I have your attention please". The fire alarm has been activated in the building. The fire alarm has been activated in the building. Please proceed to the nearest exit and leave the building." The sounding of the temporal patterned signal followed by the indicated message shall repeat indefinitely until the controlling NAC is reset.

15. Power Failure Reporting Time Delay: Main and remote NAC power supplies shall be programmed to delay the reporting of a site AC power failure for a minimum of 6 hours.

D. Device Descriptors:

1. Descriptors shall enable responding personnel to identify the location of a fire quickly and accurately, and shall indicate the status of emergency equipment or fire safety functions that might affect the safety of occupants. The minimum required information for devices intended to report smoke, fire, or fire sprinklers water flow include, but may not be limited to: Building, floor (if multiple floors exist in the building), room or space description, and device type and digital address (Smoke detector, Heat detector, Fire sprinkler water flow switch, etc.)
 - a. Building: The building must always be included in the descriptor, even if there is only one building on the site. Additional building(s) may be added at a later date creating the possibility of confusion by similar designated spaces, such as "Work room" or "Staff restroom" if more than one building has these similar designated spaces. The building designation in the descriptor must be what the site-based personnel call the building. The building should be provided with signage to aid fire department personnel in the identification of the building.
 - b. Floor: In multi-floor buildings the floor designation (1st, 2nd, etc.) must be included in the descriptor.
 - c. Room Description: The room or space description must be unique. Using the same designation for multiple spaces, such as "Workroom", "Counselor's Office", or "Men's restroom", etc. is not acceptable. If, during a project, the room numbers or the use of the room changes then the room or space descriptor must be changed to agree with the change. Proper signage should be provided for

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each space to aid fire department personnel in the identification of the room or space.

- d. **Device Type, Address and Compass Designations:** The device type and digital address must be included with the descriptor, such as smoke detector or heat detector, etc. Some systems provide this information automatically in the descriptor. Compass designations, (N, S, E, and W) are required in spaces such as corridors where there are multiple detectors and this information would be helpful to responding fire department personnel in locating the device reporting alarm. It is not necessary to include compass designations in smaller spaces where there are multiple detectors located in close proximity to each other.

E. ACCEPTABLE ABBREVIATIONS

Rm.- Room	Bldg.- Building	Smk. - Smoke
Corr.- Corridor	Lby- Lobby	Asst. - Assistant
Eng.- English	N – North	Nrs. - Nurse
Flr.- Floor	S – South	Cnclr - Counselor
Ht.- Heat	E – East	Off. - Office
Lib.- Library	W – West	PE – Physical Education
Lkr. – Locker	Kit- Kitchen	RR- Rest Room
Stu Str – Student Store	Sci - Science	By = near
Stor Rm – Store Room	Café - Cafeteria	PM – Plant Manager
1 st - First	2 nd - Second	3 rd - Third
Hopr Rm – Hopper Room	Det - Detector	Elev - Elevator
Prin – Principal	Blr Rm – Boiler Room	Conf – Conference
Park – Parking	Bsmt –Basement	MPR.- Multi-Purpose room

3.04 SYSTEM OPERATION

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- A. Unless otherwise specified, but not limited to actuation of manual stations, smoke detectors, heat detectors, linear heat or smoke detectors, or water-flow switches shall cause the following operations to occur, refer to Attachment B:
1. Activate audible circuits.
 2. Actuate strobe units until the panel is reset or strobe circuit time-out.
 3. Release magnetic door holders to doors to adjacent zones on the floor from which the alarm was initiated.
 4. Activation of fire sprinkler system low-pressure switches, post indicator valve or tamper switches shall initiate a system supervisory alarm indication.
 5. UL listed central station shall be notified via – Universal Digital Alarm Communicator Transmitter (UDACT).

3.05 TESTING

- A. A 48 hour notice shall be provided to the Project Inspector before final testing.
- B. Testing of fire detection system shall be as required by the State Fire Marshal and local authorities having jurisdiction. Installer is responsible for identifying required testing, coordinating, scheduling, and conducting tests before Substantial Completion. Tests shall include the following:
1. Operation of signal-initiating devices (smoke detectors, heat detectors, pull stations etc.).
 2. Operation of indicating devices (alarm horns, alarm bells and alarm strobes).
 3. Operation of system features under normal operation.
 4. Operation of system supervisory features.
 5. Operation of system features on standby power, with primary power turned off.
 6. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
 7. Close sprinkler system flow valves and verify proper supervisory alarm at the FACP.
 8. Verify activation of flow switches.
 9. Open initiating device circuits and verify that trouble signal actuates.
 10. Open signaling line circuits and verify that trouble signal actuates.
 11. Open and short notification appliance circuits and verify that trouble signal actuates.
 12. Open and short (wire only) network communications and verify that trouble signals are received at network annunciators or reporting terminals.

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13. Ground initiating device circuits and verify response of trouble signals.
 14. Ground signaling line circuit and verify response of trouble signals.
 15. Ground notification appliance circuit and verify response of trouble signals.
 16. Check alert tone to alarm notification devices.
 17. Check installation, supervision, and operation of intelligent smoke detectors.
 18. Alarm conditions that the system is required to detect shall 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.
 19. When the system is equipped with optional features, consult the manufacturer manual to determine proper testing procedures.
 20. Theatrical lighting house light control override.
 21. Central and Autonomous PA systems for muting during the sounding of the audible notification appliances and voice evacuation announcements.
 22. Disabling electronic tone or electromechanical bell class passing signals until system reset.
- C. Upon completion of installation of fire alarm equipment, provide to the OAR a signed, written statement confirming that fire alarm equipment was installed in accordance with the Specifications, Shop Drawings, instructions and directions provided by the manufacturer.
- D. Demonstrate in presence of the Project Inspector that circuit and wiring tests are free of shorts and grounds and that installation performs as specified herein and within manufacturer's guidelines.
- E. Software Modifications:
1. Provide the services of a factory trained and authorized technician to perform system software modification, upgrades or changes. Response time of the technician to the Project site shall not exceed 24 hours.
 2. Provide hardware, software, programming tools, and documentation necessary to modify the fire alarm network on the Project site. Modification includes: addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modification on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being provided.
- F. Complete the inspection and testing form as required by NFPA 72, and submit one copy of the completed form to the Architect and Project Inspector.

3.06 SERVICE MANUALS

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- A. Deliver to OAR, three copies of the service manuals. Each manual shall include the following:
1. Installation manuals, programming manuals and user manual if applicable for every control panel, control panel power supply, FACP input or output or relay or control module, auxiliary power supply, UDACT, remote NAC extender power supply, door holder power supplies, installed annunciators, initiating and indicating devices and addressable monitor, relay and control modules. Catalog cut sheets are not acceptable.
 2. A printed copy of the system configuration as programmed, including system labeling codes, and passwords.
 3. An electronic copy on compact disk of the system configuration program
 4. Final test report.
 5. Detailed explanation of the operation of the system.
 6. Instructions for routine maintenance.
 7. Detailed wiring diagram for the connection of relays, addressable monitor, and control or relay modules as applied in the interfacing of peripheral systems or equipment to the fire alarm system. Updated shop drawings shall include revisions made in the field via plan changes, RFIs, Field Change Directives, and any other construction change documents including interface details with ancillary systems.
 8. An electronic copy (CD) of the posted site or fire alarm map in Auto-Cad and pdf formats.
 9. Provide a CD ROM electronic copy of the updated system As-Built Drawings to the OAR, prepare this copy in the latest version of AutoCAD; along with the electronic copy provide a full size bond copy. Include one CD-ROM of the up-dated As-Built Drawings into each of the Service Manuals. CD and folded drawings shall be secured and inserted into the Service Manuals via a three-hole punched protective CD case and protective envelopes for the drawings.
 10. Provide codes and passwords for fire alarm system at testing.

3.07 SPARE PARTS

The following new spare parts shall be furnished in unopened boxes:

1. Five percent spare pull stations including the associated monitor module (minimum one spare pull station per type).
2. Five percent spare smoke and heat detectors (minimum one spare smoke and heat detector per type).
3. Five percent spare audible devices (minimum one spare audible device per type).

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4. Five percent spare strobe devices (minimum one spare strobe device per type).

3.08 SYSTEM USER AND MAINTENANCE PERSONNEL TRAINING

- A. Before Substantial Completion, provide one instruction period for the Project site based Owner operators and system users. The instruction period shall be scheduled and coordinated by the OAR.
- B. Training materials and required deliverables shall be submitted to the OAR.
 1. Prior to beginning the operational demonstration, notify Central monitoring Station that an instructional activity is beginning; inform them that it includes setting and resetting the system in test mode. After the demonstration is completed and the system restored, notify the Central Monitoring Station that the system has been restored and it is back on line for continuous monitoring.
- C. User Instruction and Training
 1. Before substantial completion and with a fully functional fire alarm system installed at the site, the contractor shall provide a minimum of four hours of user training for site based staff. The date and time for this training shall be coordinated by the project OAR.
- D. Instruction period training for site based staff shall consist of the following:
 1. Overview:
 - a. Explain the fire system is “addressable” which means every device-smoke detector, heat detector, sprinkler water flow switch, manual pull station, etc. has a unique address or identity. This makes it possible to positively identify the exact device causing an alarm, trouble or supervisory condition.
 - b. Explain the fire alarm control panel also controls the horns and strobes throughout the campus or building.
 - c. Explain that the fire alarm system is interconnected to various other systems and equipment throughout the site such as:
 - 1) Heating and air conditioning equipment to turn off fans and close dampers to stop the spread of smoke throughout a building.
 - 2) The class passing signaling system to disable the bells or tones to not accidentally signal students and staff to return to the buildings.
 - 3) Magnetically held doors to close them to stop the spread of smoke.
 - 4) To turn up house lighting in an occupied Auditorium or Multi-Purpose room to provide adequate egress lighting.

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- 5) The Central and Autonomous PA systems to mute them during the sounding of the alarm signal.
 - d. Explain the fire system has a battery backup in case of power failure and that it will continue to function for a minimum of 24 hours after a total power failure.
 - e. Explain that the fire alarm system components and wiring are monitored to report a malfunction, damage or vandalism. When this occurs, a trouble indication will appear on the fire alarm annunciator and FACP and this indication will be transmitted to the central monitoring station.
 - f. Explain that other equipment and systems are monitored for abnormal conditions such as the fire sprinkler water being turned off. When this occurs, a supervisory condition is created. A supervisory indication will appear on the fire alarm annunciator and FACP and this indication will be transmitted to the central monitoring station.
 - g. Explain that the fire system in addition to notifying the occupants of a possible fire condition also transmits an alarm indication to the central monitoring station that will in turn notify and dispatch the local fire department to your site.
2. Basic:
- a. Hand out the SYSTEM OPERATION instructions to attendees.
 - b. Point out the Fire Alarm Control Panel and have them observe the normal LED status (one green LED only should be on):
 - 1) GREEN = Normal.
 - 2) YELLOW = Trouble.
 - 3) RED = ALARM.
 - c. Have the attendees observe the LCD display that should be indicating a SYSTEM NORMAL message.
 - d. Point out the Fire Alarm System Annunciator and have attendees observe the LCD display that should be indicating a SYSTEM NORMAL message.
3. Operation and Demonstration:
- a. After putting the system or having someone put the system central station monitoring into the test mode demonstrate the following:
 - b. Activate a Manual Pull Station to demonstrate ALARM.
 - 1) Demonstrate audible and visual notification appliances and if installed the voice evacuation signal announcement.

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- 2) Demonstrate panel or annunciator sounder tone for ALARM.
 - 3) Have staff SILENCE system.
 - 4) Show LCD display and LED of alarm.
 - 5) Demonstrate and have staff reset the manual pull station.
 - 6) Have staff RESET fire system.
- c. Activate Smoke Detector with canned smoke to demonstrate address identification:
- 1) Have staff SILENCE system.
 - 2) Show LCD and display LED of ALARM.
 - 3) Have staff RESET fire system.
- d. Remove Smoke Detector to demonstrate SYSTEM TROUBLE.
- 1) Demonstrate panel or annunciator sounder tone for TROUBLE.
 - 2) Have staff SILENCE system.
 - 3) Show LCD display and LED of TROUBLE.
 - 4) Replace the smoke detector.
 - 5) Have staff RESET fire system.
- e. Remove power to demonstrate function during power failure.
- 1) Have staff SILENCE system.
 - 2) Show LCD display and LED of TROUBLE.
 - 3) Activate Manual Pull station to demonstrate audible or visual functions in power failure mode.
 - 4) Reset manual pull station.
 - 5) Reset fire system.
 - 6) If applicable, point out sprinkler riser and shut off valves.
 - 7) Show location of a water flow switch.
 - 8) Show location of a valve tamper switch.
 - 9) Point out valves must always be OPEN or fully counter clock wise.
 - 10) Point out PIV (Post Indicator Valves) if applicable.
 - 11) Have water flow through the inspectors test valve and point out the ringing water flow bell.

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- 12) After the horns are silenced by an assistant, show that the water flow bell is ringing continuously indicating water flow.
- 13) Have the assistant turn off the inspectors test valve to show that water flow alarm bell turns off.
- 14) Reset system.
- 15) Unlock and turn off a PIV or riser valve to show a supervisory condition.
- 16) Turn valve back on, lock the valve open and demonstrate the end of the indication of a supervisory condition.

4. Training documentation.

- a. Insure fire panel is reset and indicates normal and central station monitoring is taken off of the test mode.
- b. Have staff attendees sign off training sheet and provide a copy to the PROJECT INSPECTOR.

3.09 PROTECTION

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

3.10 CLEANUP

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

END OF SECTION