SPECIFICATIONS

FOR

UNLV School of Medicine Interim Space Tenant Improvement

STATE OF NEVADA

PROJECT LOCATION:

1001 Shadow Lane LAS VEGAS, NEVADA 89106

PREPARED BY

Tate Snyder Kimsey Architects 709 Valle Verde Court Henderson, Nevada 89014

CONSTRUCTION DOCUMENT SUBMITTAL

DATE: November 30, 2015

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SPECIFICATIONS

FOR

UNLV SCHOOL OF MEDICINE INTERIM SPACE TENANT IMPROVEMENT

LOCATION:

LAS VEGAS, NEVADA

OWNER

UNIVERSITY OF NEVADA LAS VEGAS

PREPARED BY

Tate Snyder Kimsey Architects, AIA 709 Valle Verde Court Henderson, Nevada 89014

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SUMMARY OF WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Contract Description.
- B. Work by Owner
- C. Contractor Use of Site and Premises.
- D. Owner Occupancy.

1.2 CONTRACT DESCRIPTION:

- A. The "Project" of which the "Work" of this contract is a part is titled UNLV Interim Tenant Space Improvements, 1001 Shadow Lane, University of Nevada Las Vegas, Shadow Lane Campus Las Vegas, Nevada 89106. The Work is to be under single general contract.
- B. The Work consists of the Interior demolition and renovation of a building on the UNLV campus.
- C. Demolition includes removal of selected walls, ceilings and flooring, salvaging of Owner property for reuse and selective mechanical and electrical demolition to support new construction
- D. Work includes new walls, ceilings, flooring, doors, casework, painting, equipment and selective mechanical and electrical work to support new construction.

1.3 WORK BY OWNER:

- A. Items noted as NIC (Not in Contract) on the drawings and schedules will be supplied and installed by the Owner. NIC items may be installed by the Owner prior to completion of the Work.
- B. Items noted as O.F.C.I (Owner Furnished Contractor Installed) will be provided by the Owner for installation by the Contractor.

1.4 CONTRACTOR USE OF SITE AND PREMISES:

- A. Limit use of site to allow Owner occupancy and use of existing adjacent facilities. Construction operations shall be limited to areas approved by the Owner.
- B. Maintain fire lanes required by local Fire Department and other access routes required by the Owner.
- C. Provide 3 day advanced notice to Owner prior to any Work than may require removal or protection of Owner equipment and material.
- D. Utility Outages and Shutdown: Provide three (3) day notice of scheduled shutdowns and immediate notification of unscheduled utility interruptions to site.
- 1.5 OWNER OCCUPANCY:

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SUMMARY OF WORK

- A. The Owner will occupy the existing buildings on campus during the course of the construction and will conduct business during the construction.
- B. Coordinate progress schedule with Owner to minimize conflict and to facilitate Owner's operation.
- C. The Owner reserves the right to control the hours of operation of selected activities, primarily dust-producing and noise producing work, which would adversely affect the occupants and use of the existing facility. The Contractor shall coordinate all such work with the Owner.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION - NOT USED.

END OF SECTION

SUMMARY OF WORK

CUTTING AND PATCHING

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Requirements and limitations for cutting and patching of Work.
- 1.2 RELATED SECTIONS:
 - A. Section 01010 Summary of Work.
 - B. Section 01770 Closeout Procedures: For final cleaning requirements.
 - C. Section 01732 Selective Demolition.

PART 2 - PRODUCTS

- 2.1 MATERIALS:
 - A. Primary Products: Those required for original installation.
 - B. Where required patch materials are not specified, use materials which will result in equal or better work than work being cut and patched in terms of performance characteristics and visual effects.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to the Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

- 3.1 EXAMINATION:
 - A. Contractor shall examine and record condition of existing work that requires cutting or removal to complete Work of this Contract.
 - B. Submit request in advance of cutting or alteration which affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - C. Examine existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
 - D. Beginning of cutting or patching means acceptance of existing conditions.

3.2 PREPARATION:

A. Contractors shall be responsible for exact location and size of all holes, sleeves, and openings

CUTTING AND PATCHING

required to be cut, formed, built-in or necessary for their work.

- B. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
- C. Protection: Protect existing 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.
- D. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- E. Provide protection from elements for areas which may be exposed by uncovering work.
- F. 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 existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
- G. Existing Hardware Removal: Where existing window and door frames remain in openings that have new products installed, complete the following:
 - 1. Remove existing hardware and hardware parts which are no longer in use.
 - 2. Patch holes remaining after removal. Fill holes more than 1/4 inch deep with wood infill, glued in place. Holes less than 1/4 inch deep may be filled with wood or with spackle.
 - 3. Patch to blend with existing surface. Sand smooth and paint to match.

3.3 CUTTING:

- A. Execute cutting and/or removal of existing construction to provide access for completion of the Work.
- B. Remove and replace defective or non-conforming work.
- C. Provide access for any required inspection and testing of the Work. Do not close or conceal any work requiring inspection or testing until acceptance.
- D. Provide openings in the Work for penetration of mechanical and electrical work.
- E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- F. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.4 PATCHING:

- A. Execute patching to complement adjacent Work.
- B. Fit Products together to integrate with other Work.
- C. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
- D. Employ installers skilled in the trades involved to perform patching for weather exposed and moisture resistant elements, and sight-exposed surfaces.

CUTTING AND PATCHING

- E. Fit work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- F. At penetrations of fire rated walls, partitions, ceiling, or floor construction, seal penetrations and voids in with firestopping material in accordance with a UL or other recognized rating laboratory listed system.
- G. Painting: Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire wall surface containing the patch to the edges of natural breaks. Provide additional coats until patch blends with adjacent surfaces.
- H. Refinish surfaces to match adjacent finish except where final finish is by others. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.5 CLEANING:

- A. Refer also to Section 01770 Closeout Procedures for final cleaning requirements.
- B. Cleaning and Restoration:
 - 1. Clean areas and spaces where cutting, coring, or patching were performed.
 - 2. Clean piping, conduit, and similar constructions before applying paint or other finishing materials.
 - 3. Restore damaged coverings of pipe and other utilities to original condition.

END OF SECTION

CUTTING AND PATCHING

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ALTERNATES

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Submission procedures Alternate items of Work as included in this Section.
 - B. Documentation of changes to Contract Sum and Contract Time

1.2 REQUIREMENTS:

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option.
- B. Accepted alternates will be identified in the Owner–Contractor Agreement.
- C. Coordinate related Work and modify surrounding Work to integrate the Work of each alternate.
- 1.3 SELECTION AND AWARD OF ALTERNATES:
 - A. Indicate lump sum for alternates, described below and list each alternate in the Bid Form Document.
 - B. The successful Bidder will be determined on base bid sum, including none or any combination of Alternates, whichever is in the best interest of the Owner.

1.4 SCHEDULE OF ALTERNATES:

- A. In general, the alternates described below shall include the cost of all labor, materials and equipment required to accomplish the work as indicated in the plans and specifications.
- B. <u>Alternate No. 1:</u> Lockers.
- C. <u>Alternate No. 2</u>: Appliances (Ref/Frz & Microwave)
- D. <u>Alternate No. 3:</u> Rubber Athletic Flooring
- E. <u>Alternate No. 4</u>: Card Reader Devices.
- F. <u>Alternate No. 5</u>: Audio/Video Equipment

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION - NOT USED.

END OF SECTION

ALTERNATES

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CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Administrative and procedural requirements for handling and processing Contract modifications.
- 1.2 RELATED REQUIREMENTS:
 - A. Section 01630 Product Substitutions for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 DEFINITIONS

- A. Modification: A Modification is defined as one of the following:
 - 1. An Architect's Supplemental Instruction; (ASI)
 - 2. A Change Order; (CO)
 - 3. A Construction Change Directive; (CCD)
 - 4. Or a written amendment to the Contract signed by Owner, Architect, and Contractor.
- 1.4 MINOR CHANGES IN THE WORK:
 - A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions (ASI).
- 1.5 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.
 - 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

CONTRACT MODIFICATION PROCEDURES

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 01630 Product Substitutions, 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.

1.6 CHANGE ORDER PROCEDURES:

- A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701. Change Orders may only be approved if the Architect agrees and signs the Change Order form.
- 1.7 CONSTRUCTION CHANGE DIRECTIVE:
 - A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714 form included in Project Manual. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
 - B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION - NOT USED.

END OF SECTION

PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Administrative and procedural requirements for preparation and submittal of:
 - 1. Schedule of Values.
 - 2. Applications for Payment.
 - 3. Progress Payments.
 - 4. Final Payment.
- B. Administrative and procedural requirements necessary to prepare and process
- 1.2 RELATED REQUIREMENTS:
 - A. Section 01250 Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - B. Section 01700 Execution Requirements.

1.3 DEFINITIONS:

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
- 1.4 SCHEDULE OF VALUES:
 - A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - Submit the schedule of values to Architect at earliest possible date, but no later than seven (7) days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 - 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
 - 5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract as described in Section 01010 Summary of Work.
 - B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

- 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
- 2. Arrange schedule of values consistent with format of AIA Document G703.
- 3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
- 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of **five** percent of the Contract Sum.
 - a. Include separate line items under **principal** subcontracts for Project closeout requirements in an amount totaling **five** percent of the Contract Sum and subcontract amount.
- 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
- 6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
- 7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
- 8. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
- 9. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
- 10. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT:

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 - 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement

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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 last 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 **AIA Document G702 and AIA Document G703** as form for Applications for Payment.
- E. Application for Payment Forms: Use forms provided by Owner for Applications for Payment. Sample copies are included in Project Manual.
- F. Application for Payment Forms: Use forms acceptable to **Architect** and Owner for Applications for Payment. Submit forms for approval with initial submittal of schedule of values.
- G. 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.
 - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- H. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 - 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- I. Transmittal: Submit **three** signed and notarized original copies of each Application for Payment to **Architect** by a method ensuring receipt **within 24 hours**. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- J. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by

the previous application.

- 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.
- K. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of values.
 - 3. Contractor's construction schedule (preliminary if not final).
 - 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 - 5. Products list (preliminary if not final).
 - 6. 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.
- L. 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.
- M. 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, "Contractor's Affidavit of Payment of Debts and Claims."
 - 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 - 6. AIA Document G707, "Consent of Surety to Final Payment."
 - 7. Evidence that claims have been settled.
 - 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

PAYMENT PROCEDURES

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PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Requests for Information (RFIs).
 - 4. Project Web site.
 - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

1.2 RELATED REQUIREMENTS:

- A. Section 01700 Execution Requirements for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
- B. Section 01732 Selective Demolition: for Pre-demolition meetings.
- C. Section 01770 Closeout Procedures for coordinating closeout of the Contract.
- D. Section 01810 General Commissioning Requirements for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS:

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

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- C. Key Personnel Names: Within fifteen (**15**) days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as

alternates in the absence of individuals assigned to Project.

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

1.5 GENERAL COORDINATION PROCEDURES:

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS:

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
 - 1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.

- b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
- c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
- d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
- e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
- f. Indicate required installation sequences.
- g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
 - 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 - 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 - 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 - 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 - 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 - 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 - 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other firealarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 - 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 - 9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being

prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01330 - Submittal Procedures.

1.7 REQUESTS FOR INFORMATION (RFIs):

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 - 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 - 1. Project name.
 - 2. Project number.
 - 3. Date.
 - 4. Name of Contractor.
 - 5. Name of Architect.
 - 6. RFI number, numbered sequentially.
 - 7. RFI subject.
 - 8. Specification Section number and title and related paragraphs, as appropriate.
 - 9. Drawing number and detail references, as appropriate.
 - 10. Field dimensions and conditions, as appropriate.
 - 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 - 12. Contractor's signature.
 - 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716, Software-generated form with substantially the same content as indicated above, acceptable to Architect.
 - 1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow **seven** (7) working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
 - 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 - 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt 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 01250 Contract Modification Procedures.

- a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within ten (**10**) days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly with not less than the following:
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect.
 - 4. RFI number including RFIs that were returned without action or withdrawn.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven (7) days if Contractor disagrees with response.
 - 1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.8 PROJECT MEETINGS:

- A. General: **Schedule and conduct** meetings and conferences at Project site unless otherwise indicated.
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within **three** (3) days of the meeting.
- B. Preconstruction Conference: **Schedule and conduct** a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than Fifteen (15) days after execution of the Agreement.
 - 1. Conduct the conference to review responsibilities and personnel assignments.
 - 2. Attendees: Authorized representatives of Owner, **Owner's Commissioning Authority**, 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.
 - 3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.
 - k. Submittal procedures.

- I. Preparation of record documents.
- m. Use of the premises and existing building.
- 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.
- 4. 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 that requires coordination with other construction.
 - 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Owner's Commissioning Authority of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - I. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded.

Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

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

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

- 12)
- Progress cleaning. Quality and work standards. 13)
- 14) Change Orders.
- Reporting: Record meeting results and distribute copies to everyone in attendance and 3. to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final completion construction photographs.

1.2 RELATED REQUIREMENTS:

- A. Section 01330 Submittal Procedures for submitting photographic documentation.
- B. Section 01732 Selective Demolition for photographic documentation before selective demolition operations commence.
- C. Section 01770 Closeout Procedures for submitting photographic documentation as project record documents at Project closeout.
- D. Section 01820 Demonstration and Training for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 ALLOWANCES:

A. Costs: Photographic documentation services are included under the cash allowance for construction photographic services established in Section 01210 - Allowances.

1.4 UNIT PRICES:

A. Basis for Bids: Base number of construction photographs on average of [20] photographs per week over the duration of Project.

1.5 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Qualification Data: For photographer and Web-based photographic documentation service provider.
- C. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- D. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Digital Camera: Minimum sensor resolution of [8] megapixels.
 - 2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
 - 3. Identification: Provide the following information with each image description in file metadata tag:

- a. Name of Project.
- b. Name and contact information for photographer.
- c. Name of Architect.
- d. Name of Contractor.
- e. Date photograph was taken.
- f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
- g. Unique sequential identifier keyed to accompanying key plan.

1.6 QUALITY ASSURANCE:

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

1.7 USAGE RIGHTS:

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

PART 2 - PRODUCTS

- 2.1 PHOTOGRAPHIC MEDIA:
 - A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of [8] megapixels, and at an image resolution of not less than [3200 by 2400] pixels.

PART 3 - EXECUTION

- 3.1 CONSTRUCTION PHOTOGRAPHS:
 - A. Photographer: Engage a qualified photographer to take construction photographs.
 - B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
 - C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 - 1. Date and Time: Include date and time in file name for each image.
 - 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect and Construction Manager.
 - D. Preconstruction Photographs: Before commencement of demolition, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect or Construction Manager.
 - 1. Flag construction limits before taking construction photographs.
 - 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

PHOTOGRAPHIC DOCUMENTATION

- E. Periodic Construction Photographs: Take 20 photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- F. Architect or Construction Manager-Directed Construction Photographs: From time to time, the Architect or Construction Manager will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- G. Time-Lapse Sequence Construction Photographs: Take (20) photographs as indicated, to show status of construction and progress since last photographs were taken.
 - 1. Frequency: Take photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment.
 - 2. Vantage Points: Following suggestions by Architect or Construction Manager and Contractor, photographer to select vantage points. During each of the following construction phases, take not less than two (2) of the required shots from same vantage point each time to create a time-lapse sequence as follows:
 - a. Commencement of the Work, through completion of subgrade construction.
 - b. Above-grade structural framing.
 - c. Exterior building enclosure.
 - d. Interior Work, through date of Substantial Completion.
- H. Final Completion Construction Photographs: Take min. (20) color photographs after date of Substantial Completion for submission as project record documents. Architect or Construction Manager will inform photographer of desired vantage points.
 - 1. Do not include date stamp.
- I. Additional Photographs: Architect or Construction Manager may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
 - 1. Three days' notice will be given, where feasible.
 - 2. In emergency situations, take additional photographs within 24 hours of request.
 - 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.

END OF SECTION
SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

- 1.1 SECTION INCLUDES:
 - A. Delegated-Design Services.
 - B. Submittals.
 - 1. Submittal Schedule.
 - 2. Submittals for Review.
 - 3. Submittals for Information.
 - 4. Submittals for Project Closeout.
 - 5. Number of copies of submittals.
 - 6. Submittal procedures.
 - C. Engineered Deferred Submittals.

1.2 RELATED SECTIONS:

- A. General Conditions of the Contract.
- B. Section 01400 Quality Requirements.
- C. Section 01770 Closeout Procedures.
- 1.3 DELEGATED-DESIGN SERVICES:
 - A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of General Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
 - B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to General 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.
 - C. Refer to Paragraph 3.7 Engineered Deferred Submittals.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.1 SUBMITTALS SCHEDULE:

- A. After the General Contractor's Construction Schedule has been developed and accepted, prepare a complete schedule of submittals.
 - 1. Two weeks after notice to proceed, General Contractor shall prepare the Submittals Requirements Schedule in detail:
 - a. Use one line per item for each section and paragraph number
 - b. Provide one copy for the Owner and one copy for the Architect of Record.
 - c. Obtain Architect of Record's and Project Manager's approvals
 - 2. Coordinate the Submittal Schedule with the General Contractor's Construction Schedule, Schedule of Values, Subcontracts, list of products and other pertinent information.
 - 3. Coordinate submittals into logical groupings to facilitate interrelation of several items:
 - a. Finishes which involve Architect of Record selection of colors, textures or patterns.
 - b. Associated items which require correlation for efficient function or for installation.
 - c. Provide:
 - 1) All submittals required by a particular section at one time.
 - 2) Shop drawings, schedules, product data, coordination drawings, samples, color charts and other information as required (whether listed or not) for Architect of Record's complete evaluation.
 - 3) Define the deferred submittal schedule.
 - d. Incomplete information or partial submittals will be cause for rejection.
 - 4. Prepare the schedule in chronological order and provide the following:
 - a. Scheduled date for the initial submittal.
 - b. Section number per this specification.
 - c. Submittal category (Shop Drawing, Product Data or Sample).
 - d. Name of General Contractor.
 - e. Description of the part of the work covered by this submittal.
 - f. Date required for this submittal to be returned but not less than the stipulated date herein.
- B. After approval of the Submittal Schedule, distribute in print and electronically in pdf format to the Owner's representative, Architect, subcontractors and all other parties required to comply with the dates indicated in the Submittal Schedule.
 - 1. Submit the Submittal Schedule within 10 days of the date required for submittal of the General Contractor's Construction Schedule.
- C. Update and reissue the Submittal Schedule after revised dates, agreed upon by the affected parties, have been approved.
- D. Submittal schedule shall be updated periodically to reflect changes in the construction schedule.
- 3.2 SUBMITTALS FOR REVIEW:

1.

- A. Submittals shall be numbered according to Architect's Project Manual of Specifications.
- B. When the following are specified in individual sections, submit them for review:
 - Product data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - a. Submit only pages which are pertinent. Mark each copy of standard printed data to identify relevant products and the related Specification Section and Article Number.
 - b. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - c. Mark each copy of each submittal to show which products and options are

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applicable.

- d. Include the following information, as applicable:
 - 1) Manufacturer's catalog cuts.
 - 2) Manufacturer's product specifications.
 - 3) Performance characteristics and capacities
 - 4) Finishes
 - a) Standard color charts.
 - 5) Component parts
 - 6) Statement of compliance with specified referenced standards.
 - 7) Testing by recognized testing agency.
 - 8) Application of testing agency labels and seals.
 - 9) Notation of coordination requirements.
 - 10) Other information as required by the individual specification sections
 - 11) Availability and delivery time information.
- e. For equipment, include the following in addition to the above, as applicable:
 - 1) Wiring diagrams showing factory-installed wiring.
 - 2) Printed performance curves.
 - 3) Operational range diagrams.
 - 4) Dimensions
 - 5) Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- f. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the Work. Delete information that is not applicable.
- g. Submit Product Data before or concurrent with Samples.
- h. Submit Product Data in the following format:
 - 1) PDF electronic file.
- 2. Shop drawings: Submit newly prepared Project-specific information, drawn accurately to scale.
 - a. Do not reproduce Contract Documents or copy standard product information as the basis of Shop Drawings.
 - 1) Submittals received on the Architect's Titleblock will be automatically rejected.
 - b. Present in a clear and thorough manner Job Specific shop drawings. (Generic shop drawings will be rejected.) Title each drawing sheet with Project Name and Number; identify each element of the drawings by reference to Sheet Number and Detail, Specification Section, Schedule or Room Number listed in the Contract Documents and CAD Standards Manual.
 - c. Standard information prepared without specific reference to the Project is not a Shop Drawing.
 - d. Identify field dimensions; show relation to adjacent or critical features of Work or Products.
 - e. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - 1) Identification of products.
 - 2) Schedules.
 - 3) Compliance with specified standards.
 - 4) Notation of coordination requirements.
 - 5) Notation of dimensions established by field measurement.
 - 6) Relationship and attachment to adjoining construction clearly indicated.
 - 7) Seal and signature of professional engineer if specified.
 - f. Scale Required: Unless otherwise specifically directed by Architect of Record, make all shop drawings accurate to a scale sufficiently large enough to show all pertinent features of the item and its methods of connection to the Work.
 - g. Submit Shop Drawings in the following format:
 - 1) PDF electronic file.

- h. Provide a 5" x 4" blank space on each submittal sheet or sample label for Architect of Record's review stamp.
- C. Samples for Selection:
 - 1. Provide 4 of each sample or color chart.
 - 2. Submit full range of manufacturer's standard finishes, except when more restrictive requirements are specified, indicating colors, textures, and patterns, for Architect of Record's selection. ALL color charts shall be originals, no photocopies allowed.
 - 3. Submit samples to illustrate functional characteristics of products, including parts and attachments.
 - 4. Label each sample with Project Name and Number, Interior Design Specification Number (as applicable), and Room Number.
 - 5. Mock-up: Provide field samples of finishes and assemblies at the site as required by individual specification sections.
 - a. Install each sample or assembly complete and finished.
 - b. Locate as directed by the Owner or Architect of Record.
 - c. Acceptable mock-up may or may not remain as part of the Work at the Architect of Record's discretion.
- D. Samples for Verification:
 - 1. Provide 6 of each sample or color chart.
 - 2. Submit full range of manufacturer's standard finishes, except when more restrictive requirements are specified, indicating colors, textures, and patterns, for Architect of Record's selection. ALL color charts shall be originals, no photocopies allowed.
 - 3. Submit samples to illustrate functional characteristics of products, including parts and attachments.
 - 4. Label each sample with Project Name and Number, Interior Design Specification Number (as applicable), and Room Number.
- E. Samples will be reviewed only for aesthetic, color, or finish selection.
 - 1. Submit sample of material in size, finish, texture and color as required by the specific specification section and indicating the range of any variations that may occur.
- F. After review, provide copies and distribute in accordance with **Submittal Procedures** article below and for record documents purposes described in Section 01770 Closeout Procedures.
- G. Fire Alarm/Fire Sprinkler System Shop Drawings shall be submitted to the Architect whose approval shall be obtained prior to the submittal to the state and local Fire Marshall.

3.3 SUBMITTALS FOR INFORMATION:

- A. When the following are specified in individual sections, submit them for information:
 - 1. Design data.
 - 2. Certificates.
 - 3. Test reports.
 - 4. Inspection reports.
 - 5. Manufacturer's instructions.
 - 6. Manufacturer's field reports.
 - 7. Other types indicated.
- B. Submit for Architect's knowledge as the Owner's Contract Administrator or for the Owner's record. No action will be taken.
- 3.4 SUBMITTALS FOR PROJECT CLOSEOUT:
 - A. When the following are specified in individual sections, submit them at project closeout:

- 1. Project record documents.
- 2. Operation and maintenance data.
- 3. Warranties & Bonds
- 4. Other types as indicated.
- B. Submit for Owner's benefit during and after project completion and in accordance with Section 01770 Closeout Procedures.

3.5 NUMBER OF COPIES OF SUBMITTALS:

- A. Documents for Review:
 - 1. Small Size Sheets, Not Larger than 8-1/2 x 11 inches: Submit one electronic copy; the Contractor shall make his own copies from original returned by the Architect after making his own file copy.
- B. Documents for Information: Submit one electronic copy to Architect of Record.
- C. Extra Copies at Project Closeout: See Section 01781. Make one reproduction of submittal originally reviewed. Submit one extra of submittals for information.
- D. Samples: Submit the number specified in individual specification sections or 4 of each if no specific number is specified in the specific section; one of which will be retained by Architect.
 - 1. After review, produce duplicates.
 - 2. Retained samples will not be returned to Contractor unless specifically so stated.

- A. All submittals shall be in accordance with the General Conditions of the Contract.
- B. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
- C. Schedule submittals to expedite the Project and coordinate submission of related items. The General Contractor is solely responsible for coordinating the delivery of submittals, including any necessary corrections and resubmittals, to assure that Architect of Record approval can be obtained without delaying the Work. The General Contractor shall start the submittal process within three weeks after award or as required to meet the Contract Schedule requirements.
- D. Transmit each submittal with a copy of approved submittal form.
- E. General: Electronic copies of the digital files of the Construction Documents may be made available by the Architect for the General Contractor's use in the preparation of the Submittals. The Architect nor the General Contractor shall be obligated to use such documents in the preparation of the Submittals.
 - 1. Transfer of the digital files from the Architect to the General Contractor shall be subject to the Terms and Conditions of a Digital File Transfer Agreement at the time of such transfer.
 - 2. The use of the digital files prepared by the Architect in the preparation of the Shop Drawings shall not in any way obviate the recipient's responsibility for the proper checking and coordination of dimensions, field conditions, details, member sizes, gauges, quantities, and any other condition as required to facilitate complete and accurate fabrication and erection.
- F. Transmit each submittal with approved form.

- G. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
- H. Identify Project Manager, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.
- I. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
- J. General Contractor Review:
 - 1. Review submittals (prior to sending to Architect of Record) to determine and verify field measurements, field construction criteria, manufacturer's catalog numbers, and conformance of submittal with requirements of Contract Documents.
 - 2. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
 - 3. Coordinate submittals with requirements of Work and Contract Documents.
 - 4. Sign or initial each sheet of shop drawings and product data or each sample label to certify compliance with the requirements of Contract Documents using a submittal stamp with the following information incorporated:
 - a. General Contractor Submittal Approval
 - b. By making this Submittal No. _____, (Insert General Contractor's Name) does hereby approve said submittal and does certify that it has determined and verified all materials, field measurements and field construction criteria related thereto, and has checked and coordinated the information within this submittal with the requirements of the Work and Contract Documents.
 - c. Signed for the General Contractor: _____ Date: _____.
- K. Submittal Mark-ups:
 - 1. Submittals shall be marked-up as follows:
 - a. Contractor Comments: Make all Contractor comments in "Blue" ink.
 - b. Design Team will make all comments in "Red" ink.
- L. Identify Project number, General Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy. Architect will not review submittals that do not bear the General Contractor's approval stamp and will return them without action.
- M. Apply General Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
- N. All submittals **NOT** made through the General Contractor will be rejected.
- O. The Architect will return unsolicited submittals without action.
- P. No portion of the Work which requires a shop drawing or sample submission shall be commenced until the submission has been reviewed and returned as approved by Architect of Record.
- Q. Deliver physical submittals to Architect at business address.
- R. Schedule submittals to expedite the Project, and coordinate submission of related items.
- S. For each submittal for the initial review, allow 10 days excluding delivery time to and from the Contractor.

- 1. For concurrent review of submittals by Consultants, Owner and other parties, allow 5 additional days excluding time to and from the Contractor.
- 2. Extension of review time shall not constitute a basis to automatically extend the Contract time.
- T. For each resubmittal, allow for 14 days excluding time to and from the General Contractor.
- U. Submittals and Samples shall be submitted in a timely manner to allow for resubmittal and not cause a delay in the Work.
- V. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.
- W. Provide space of approximately 5" x 4" for Contractor and Architect review stamps.
 - General Contractor shall include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.

1.

- c. Project number.
- d. Name and address of Architect.
- e. Name and address of General Contractor.
- f. Name and address of Subcontractor.
- g. Name and address of Supplier.
- h. Name of Manufacturer.
- i. Unique identifier, including revision number(s).
- j. Number and title of appropriate Specification Section.
- k. Drawing number and detail references, as appropriate.
- I. Other necessary identification.
- 2. Architect shall mark the action stamp indicating the action taken.
- X. When revised for resubmission, identify all changes made since previous submission.
 - 1. The General Contractor shall make any corrections required by the Architect of Record and resubmit.
 - a. The General Contractor shall direct specific attention in writing or on the resubmitted shop drawings to revisions other than the correction(s) required by Architect of Record on previous submissions.
 - b. When revised for resubmission, identify all changes made since previous submission.
 - c. The revised submittal will be identified with the original submittal number plus a suffix to mark it as a resubmittal, i.e. 005-09910-R1, 005-09910-a or 005-09910-A. If not so identified, the resubmittal will be returned as revise and resubmit with the proper number.
- Y. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- Z. Electronic submittals must be provided in a portable Document Format (.pdf) file when submitted electronically.
 - 1. Prepare file for submittal by converting it to PDF using Adobe Acrobat Pro 9.0® or later version. Legible scanned PDF files of plain paper documents are acceptable, but PDF sets created by electronically converting files using Adobe Acrobat Pro® are preferable. Scanned documents are more difficult to annotate, are usually less legible, and produce larger attachment sizes.
 - 2. Ensure that sheets are ready to print out to a PDF format on the appropriate sheet size, with no additional formatting required by the viewer, and with all required information.
 - 3. The option in Adobe Acrobat Pro® to print "Documents and Markups" in the "Print

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What" drop down list on the "Print" options window must be chosen to correctly see all applicable information in the request answer. This will ensure all pertinent information is printed if the document is printed.

- 4. Electronic signatures and stamps must be utilized on electronic submittals where signatures and stamps are required in Section 3.1 Submittal Schedule items A.1-4 and Section 3.6 Submittal Procedures items A-X above.
- AA. Substitutions will not be considered when they are indicated or implied on shop drawings, product data submittals or samples without a separate written request complying with the requirement in Section 01630 Product Substitutions.
- BB. Maintain one (1) set of all approved submittals at the Project Site in the General Contractors office.

3.7 ENGINEERED DEFERRED SUBMITTALS:

- A. Definition: Per 2012 International Building Code (IBC) (Section 107.3.4.2).
 - 1. Portions of the design that are not submitted at the time of the (permit) application and that are to be submitted to the building official within a specified period."
- B. Documents for deferred submittal items shall be submitted to the registered design professional in responsible charge [EOR], (through the Architect of Record), who shall review them and forward them, to the General Contractor, who will forward them to the building official with a notation indicating that the deferred documents have been reviewed and found to be in general conformance to the design of the building.
- C. Contractor is responsible for making all submittals of deferred items to the Building Officials, (AHJ).
- D. Refer to deferred submittal items on the Construction Documents.
- E. Deferred Submittals include but are not limited to the following list. Provide as applicable to the Project.
 - 1. Acoustical ceiling suspension system with manufacturer instructions required.
 - 2. Ceiling Framing systems.
 - 3. Electrical System Plans, specifications and calculations.
 - 4. Emergency call system.
 - 5. Exit illumination.
 - 6. Through-penetration fire stop systems and spray fireproofing submittal data.
 - 7. HVAC system plans, specifications and calculations.
 - 8. Shelving systems and steel storage racks
- F. Deferred submittal documents and drawings must be submitted and approved prior to the construction/installation of the deferred item.
- G. All pre-engineered, pre-fabricated, pre-manufactured or other products designed after issuance of a permit must be designed for loads and deflection criteria as required by the applicable edition of the International Building Code (IBC).

END OF SECTION

SECTION 01400

QUALITY REQUIREMENTS

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Tolerances.
 - B. Control of installation.
 - C. Testing and inspections.
 - D. Manufacturers' field services and reports.

1.2 RELATED SECTIONS:

- A. Section 01330 Submittal Procedures.
- B. Section 01600 Product Requirements.
- C. Individual Specification Sections.

1.3 REFERENCE STANDARDS:

- A. ASTM C1021 Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2014).
- B. ASTM C1077 Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2014.
- C. ASTM C1093 Standard Practice for Accreditation of Testing Agencies for Masonry; 2013.
- D. ASTM E329 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2014a.
- E. ASTM E543 Standard Specification for Agencies Performing Nondestructive Testing; 2013.
- F. IAS AC89 Accreditation Criteria for Testing Laboratories; 2010.

1.4 TOLERANCES:

- A. Monitor tolerance control of installed Products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents; request clarification from Architect/Engineer before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.

PART 2 - PRODUCTS - NOT USED.

QUALITY CONTROL

PART 3 - EXECUTION

3.1 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.2 TESTING AND INSPECTIONS:

- A. See individual specification sections for testing and inspection required. The following list is only intended to be a guide for the Contractor to aid in determining the testing requirements for the Project. The requirements specified in each specific section shall take precedence over this list and this list is not to be interpreted as being a complete list.
 - 1. 03300 Cast-in-Place Concrete
 - 2. 05120 Structural Steel Framing.
 - 3. 05310 Steel Decking.
 - 4. 05400 Cold-Formed Metal Framing.
 - 5. 07811 Spray Applied Fire Resistive Materials.
 - 6. 07841 Firestopping
 - 7. 07900 Exterior Joint Sealants
 - 8. 08411 Aluminum Entrances and Storefront Systems
 - 9. 08800 Glass and Glazing
 - 10. Division 9 Flooring Sections regarding moisture content of concrete floors.
- B. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 4. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
 - 5. Perform additional tests and inspections required by Architect.
 - 6. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
 - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.

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QUALITY CONTROL

- 2. Agency may not approve or accept any portion of the Work.
- 3. Agency may not assume any duties of Contractor.
- 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
 - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 - 2. Cooperate with laboratory personnel, and provide access to the Work.
 - 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 - 4. Notify laboratory 24 hours minimum, in advance, prior to expected time for operations requiring testing/inspection services.
 - 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 - 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- E. The Owner will employ and pay for services of an independent testing laboratory to perform the following specified inspecting and testing:
 - 1. Initial testing of materials as selected by the Owner under the provisions of the General Conditions.

3.3 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and others as applicable, and to initiate instructions when necessary.
- B. Such Manufacturer's personnel shall be accompanied by the Contractor during his time at the site.
- C. Submit qualifications of observer to Architect 30 days in advance of required observations.
 1. Observer subject to approval of Owner.
- D. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.4 DEFECT ASSESSMENT

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
 - 2. Comply with the Contract Document requirements for Section 01045 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.

- D. Replace Work or portions of the Work not conforming to specified requirements.
- E. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION

QUALITY CONTROL

SECTION 01420

REFERENCES

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. This section supplements the definitions contained in the General Conditions.
 - B. Other definitions are included in individual specification sections.

1.2 DEFINITIONS:

- A. "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.
- B. "Approved equal", "or equal" shall mean as approved and accepted by the Architect and/or Owner.
- C. "As necessary" means essential to the completion of the work.
- D. "As required" means as required by the contract documents.
- E. "As selected", "as approved" or words of similar import mean as selected by, as approved by, or as accepted by the Architect and/or Owner.
- F. "As shown", "as detailed", "as indicated" or words of similar import mean as indicated on the drawings.
- G. "Clear" shall mean to hold to a dimension certain.
- H. "Concealed" means not visible in the finished work.
- I. "Exposed" means visible in the finished work.
- J. "Connect": To make the complete necessary utility connection (water, sewer, gas, electricity, etc.) from the building utility to the piece of equipment to allow that piece of equipment to function as intended (e.g., a gas connection for an oven or cooktop).
- K. "Days" means calendar days.
- L. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- M. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- N. "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."
- O. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assem-

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bling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

- P. "Product": Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- Q. "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.
- R. "Provide": Furnish and install, complete and ready for the intended use.
- S. "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.
- T. "Shall" means mandatory.
- U. "Supply": Same as Furnish.
- V. "Working Days" means work days and does not include legal holidays as defined by the Contract.
- 1.3 OWNER FURNISHED OWNER INSTALLED ITEMS (OFOI):
 - A. General: The terms "Furnish," "Install," and "Connect" shall be as defined in Paragraph 1.2 of this Section.
 - B. Items furnished and installed by the Owner: Refer to Contract for OFOI items.
 - C. Contractor's Responsibilities:
 - 1. Contractor shall give the Owner written notification, stating the date(s) when the Owner Furnished items must be received at the job site to insure Project completion in accordance with the established schedule. Such dates shall be shown on the schedule.
 - 2. Contractor is responsible for the coordination and interface of the Owner-Furnished and Installed Items (OFOI) with the Work of this Contract to provide all necessary mechanical and electrical rough-ins, openings, supports, dimensions, clearances, etc., required for a complete and functional installation.

1.4 OWNER FURNISHED - CONTRACTOR INSTALLED ITEMS (OFCI):

- A. General: The terms "Furnish," "Install," and "Connect" shall be as defined in Paragraph 1.2 of this Section.
- B. Items furnished by the Owner and installed by the Contractor: Refer to Contract for OFCI items.
- C. Owner's Responsibilities:
 - 1. Arrange for and deliver Owner reviewed Shop Drawings, Product Data, and Samples, to the Contractor.
 - 2. Arrange and pay for product delivery to site.
 - 3. Upon delivery, inspect products jointly with Contractor.
 - 4. Immediately upon observing the product, submit any claims for transportation damage and replace damaged, defective, or deficient items.
 - 5. Arrange for Manufacturers' warranties, inspections and service.

- D. Contractor's Responsibilities:
 - 1. Contractor shall provide a written schedule to the Owner, indicating when the Owner-Furnished items must be received at the project site to insure the Project completion in accordance with the established schedule. Such dates shall be shown on the schedule.
 - 2. Review of the Owner-reviewed Shop Drawings, Product data, and Samples.
 - 3. Receive and unload products at the site. Inspect for completeness or damage jointly with the Owner.
 - 4. Handle, store, assemble, install, protect, connect and finish products including furnishing lubricants and fluids and other procedures necessary to cause products to be operative and serviceable.
 - 5. Contractor shall be responsible for the coordination with the Owner- Furnished items and to provide for all of the necessary mechanical and electrical rough-ins, openings, supports, dimensions, clearances, etc. required for a complete and functional installation.

1.5 SPECIFICATION FORMAT AND CONTENT EXPLANATION:

- A. Specifications are organized into Divisions and Sections based on 50-division format and CSI/CSC's "Master Format" numbering system.
- B. Specifications use certain conventions for style of language and intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated. Interpret singular words as plural and plural words as singular where applicable, as context of Contract Documents indicates.
 - a. Words "shall," "shall be," or "shall comply with," depending on context, are implied where colon (:) is used within sentence or phrase.

1.6 INDUSTRY STANDARDS:

1.

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.7 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 in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AABC	Associated Air Balance Council www.aabc.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664

AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists www.aatcc.org	(919) 549-8141
ABMA	American Bearing Manufacturers Association www.americanbearings.org	(202) 367-1155
ACI	American Concrete Institute (Formerly: ACI International) www.concrete.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700
AGA	American Gas Association www.aga.org	(202) 824-7000
АНАМ	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AHRI	Air-Conditioning, Heating, and Refrigeration Institute (The) www.ahrinet.org	(703) 524-8800
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	Association of Official Seed Analysts, Inc. www.aosaseed.com	(607) 256-3313

REFERENCES

APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute (See AHRI)	
ARI	American Refrigeration Institute (See AHRI)	
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	
ASHRAE	American Society of Heating, Refrigerating and Air-	(800) 527-4723
	www.ashrae.org	(404) 636-8400
ASME	ASME International (American Society of Mechanical Engineers) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Safety Engineers (The) www.asse.org	(847) 699-2929
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9500
ATIS	Alliance for Telecommunications Industry Solutions www.atis.org	(202) 628-6380
AWEA	American Wind Energy Association www.awea.org	(202) 383-2500
AWI	Architectural Woodwork Institute www.awinet.org	(571) 323-3636
AWMAC	Architectural Woodwork Manufacturers Association of Canada www.awmac.com	(403) 453-7387

REFERENCES

AWPA	American Wood Protection Association (Formerly: American Wood-Preservers' Association) www.awpa.com	(205) 733-4077
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.gobrick.com	(703) 620-0010
BICSI	BICSI, Inc. www.bicsi.org	(800) 242-7405 (813) 979-1991
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association) www.bifma.com	(616) 285-3963
BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(866) 342-4772
BOCA	BOCA (Building Officials and Code Administrators International Inc.) (See ICC)	
BWF	Badminton World Federation (Formerly: International Badminton Federation) www.bwfbadminton.org	60 3 9283 7155
CDA	Copper Development Association www.copper.org	(800) 232-3282 (212) 251-7200
CEA	Canadian Electricity Association www.electricity.ca	(613) 230-9263
CEA	Consumer Electronics Association www.ce.org	(866) 858-1555 (703) 907-7600
CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CFSEI	Cold-Formed Steel Engineers Institute www.cfsei.org	(866) 465-4732 (202) 263-4488
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
ILV School of Me	dicine	REFE

CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(404) 622-0073
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
СРА	Composite Panel Association www.pbmdf.com	(703) 724-1128
CRI	Carpet and Rug Institute (The) www.carpet-rug.org	(706) 278-3176
CRRC	Cool Roof Rating Council www.coolroofs.org	(866) 465-2523 (510) 485-7175
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(800) 328-6306 (847) 517-1200
CSA	Canadian Standards Association www.csa.ca	(800) 463-6727 (416) 747-4000
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(866) 797-4272 (416) 747-4000
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau www.cedarbureau.org	(604) 820-7700
СТІ	Cooling Technology Institute (Formerly: Cooling Tower Institute) www.cti.org	(281) 583-4087
CWC	Composite Wood Council (See CPA)	
DASMA	Door and Access Systems Manufacturers Association www.dasma.com	(216) 241-7333
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
ECA	Electronic Components Association www.ec-central.org	(703) 907-8024
ECAMA	Electronic Components Assemblies & Materials Association (See ECA)	
EIA	Electronic Industries Alliance (See TIA)	

EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (703) 538-1616
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association (Electrostatic Discharge Association) www.esda.org	(315) 339-6937
ESTA	Entertainment Services and Technology Association (See PLASA)	
EVO	Efficiency Valuation Organization www.evo-world.org	(415) 367-3643 44 20 88 167 857
FM Approvals	FM Approvals LLC www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG - FM Global) www.fmglobal.com	(401) 275-3000
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc. www.floridaroof.com	(407) 671-3772
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council U.S. www.fscus.org	(612) 353-4511
GA	Gypsum Association www.gypsum.org	(301) 277-8686
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GS	Green Seal www.greenseal.org	(202) 872-6400
н	Hydraulic Institute www.pumps.org	(973) 267-9700
HI/GAMA	Hydronics Institute/Gas Appliance Manufacturers Association (See AHRI)	
НММА	Hollow Metal Manufacturers Association (See NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc.	(410) 838-6550

REFERENCES

	www.hpwhite.com	
IAPSC	International Association of Professional Security Consultants www.iapsc.org	(415) 536-0288
IAS	International Approval Services (See CSA)	
ICBO	International Conference of Building Officials (See ICC)	
ICC	International Code Council www.iccsafe.org	(888) 422-7233 (202) 370-1800
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICPA	International Cast Polymer Alliance www.icpa-hq.org	(703) 525-0511
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IES	Illuminating Engineering Society (Formerly: Illuminating Engineering Society of North America) www.ies.org	(212) 248-5000
IESNA	Illuminating Engineering Society of North America (See IES)	
IEST	Institute of Environmental Sciences and Technology www.iest.org	(847) 981-0100
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
IGSHPA	International Ground Source Heat Pump Association www.igshpa.okstate.edu	(405) 744-5175
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426
Intertek	Intertek Group (Formerly: ETL SEMCO; Intertek Testing Service NA) www.intertek.com	(800) 967-5352
ISA	International Society of Automation (The) (Formerly: Instrumentation, Systems, and Automation Society)	(919) 549-8411

REFERENCES

	www.isa.org	
ISAS	Instrumentation, Systems, and Automation Society (The) (See ISA)	
ISFA	International Surface Fabricators Association (Formerly: International Solid Surface Fabricators Association) www.isfanow.org	(877) 464-7732 (801) 341-7360
ISO	International Organization for Standardization www.iso.org	41 22 749 01 11
ISSFA	International Solid Surface Fabricators Association (See ISFA)	
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11
КСМА	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LMA	Laminating Materials Association (See CPA)	
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MCA	Metal Construction Association www.metalconstruction.org	(847) 375-4718
MFMA	Maple Flooring Manufacturers Association, Inc. www.maplefloor.org	(888) 480-9138
MFMA	Metal Framing Manufacturers Association, Inc. www.metalframingmfg.org	(312) 644-6610
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
MMPA	Moulding & Millwork Producers Association (Formerly: Wood Moulding & Millwork Producers Association) www.wmmpa.com	(800) 550-7889 (530) 661-9591
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937 (604) 298-7578
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.	(703) 281-6613

www.mss-hq.org NAAMM National Association of Architectural Metal Manufacturers (630) 942-6591 www.naamm.org NACE NACE International (800) 797-6223 (National Association of Corrosion Engineers International) (281) 228-6200 www.nace.org NADCA National Air Duct Cleaners Association (202) 737-2926 www.nadca.com NAIMA North American Insulation Manufacturers Association (703) 684-0084 www.naima.org NBGQA National Building Granite Quarries Association, Inc. (800) 557-2848 www.nbgqa.com NCAA National Collegiate Athletic Association (The) (317) 917-6222 www.ncaa.org **NCMA** National Concrete Masonry Association (703) 713-1900 www.ncma.org NEBB National Environmental Balancing Bureau (301) 977-3698 www.nebb.org NECA National Electrical Contractors Association (301) 657-3110 www.necanet.org NeLMA Northeastern Lumber Manufacturers Association (207) 829-6901 www.nelma.org NEMA National Electrical Manufacturers Association (703) 841-3200 www.nema.org NETA InterNational Electrical Testing Association (888) 300-6382 www.netaworld.org (269) 488-6382 NFHS National Federation of State High School Associations (317) 972-6900 www.nfhs.org **NFPA** NFPA (800) 344-3555 (National Fire Protection Association) (617) 770-3000 www.nfpa.org NFRC National Fenestration Rating Council (301) 589-1776 www.nfrc.org NHLA National Hardwood Lumber Association (800) 933-0318 www.nhla.com (901) 377-1818 NLGA National Lumber Grades Authority (604) 524-2393 www.nlga.org **NOFMA** National Oak Flooring Manufacturers Association

(See NWFA)	
National Ornamental & Miscellaneous Metals Association www.nomma.org	(888) 516-8585
National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
National Society of Professional Engineers www.nspe.org	(703) 684-2800
National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
National Terrazzo & Mosaic Association, Inc. (The) www.ntma.com	(800) 323-9736
National Wood Flooring Association www.nwfa.org	(800) 422-4556 (636) 519-9663
Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720
Research Council on Structural Connections www.boltcouncil.org	
Resilient Floor Covering Institute www.rfci.com	(706) 882-3833
Redwood Inspection Service www.redwoodinspection.com	(925) 935-1499
SAE International (Society of Automotive Engineers) www.sae.org	(877) 606-7323 (724) 776-4841
Southern Building Code Congress International, Inc. (See ICC)	
Society of Cable Telecommunications Engineers www.scte.org	(800) 542-5040 (610) 363-6888
Steel Deck Institute www.sdi.org	(847) 458-4647
Steel Door Institute	(440) 899-0010
	 (See NWFA) National Ornamental & Miscellaneous Metals Association www.nomma.org National Roofing Contractors Association www.nrca.net National Ready Mixed Concrete Association www.nrca.org NSF International (National Sanitation Foundation International) www.nsf.org National Society of Professional Engineers www.nspe.org National Stone, Sand & Gravel Association www.nsga.org National Terrazzo & Mosaic Association, Inc. (The) www.ntma.com National Wood Flooring Association www.nwfa.org Precast/Prestressed Concrete Institute www.pci.org Plumbing & Drainage Institute www.pdionline.org Research Council on Structural Connections www.boltcouncil.org Resilient Floor Covering Institute www.rfci.com SAE International (Society of Automotive Engineers) www.sea.org Southern Building Code Congress International, Inc. (See ICC) Society of Cable Telecommunications Engineers www.scie.org Steel Deck Institute www.sdi.org Steel Door Institute

	www.steeldoor.org	
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(877) 294-5424 (516) 294-5424
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)	
SIA	Security Industry Association www.siaonline.org	(866) 817-8888 (703) 683-2075
SJI	Steel Joist Institute www.steeljoist.org	(843) 293-1995
SMA	Screen Manufacturers Association www.smainfo.org	(773) 636-0672
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SMPTE	Society of Motion Picture and Television Engineers www.smpte.org	(914) 761-1100
SPFA	Spray Polyurethane Foam Alliance www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau www.spib.org	(850) 434-2611
SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026
SRCC	Solar Rating and Certification Corporation www.solar-rating.org	(321) 638-1537
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWPA	Submersible Wastewater Pump Association www.swpa.org	(847) 681-1868
TCA	Tilt-Up Concrete Association www.tilt-up.org	(319) 895-6911
TCNA	Tile Council of North America, Inc.	(864) 646-8453

REFERENCES

	(Formerly: Tile Council of America) www.tileusa.com	
TEMA	Tubular Exchanger Manufacturers Association, Inc. www.tema.org	(914) 332-0040
ΤΙΑ	Telecommunications Industry Association (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance) www.tiaonline.org	(703) 907-7700
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance (See TIA)	
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
TPI	Truss Plate Institute www.tpinst.org	(703) 683-1010
TRI	Tile Roofing Institute www.tileroofing.org	(312) 670-4177
UBC	Uniform Building Code (See ICC)	
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USGBC	U.S. Green Building Council www.usgbc.org	(800) 795-1747
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association www.wcmanet.org	(212) 297-2122
WDMA	Window & Door Manufacturers Association www.wdma.com	(800) 223-2301 (312) 321-6802
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California) www.wicnet.org	(916) 372-9943
WMMPA	Wood Moulding & Millwork Producers Association (See MMPA)	
WSRCA	Western States Roofing Contractors Association	(800) 725-0333
ILV School of M	edicine	REFE

REFERENCES

	www.wsrca.com	(650) 938-5441
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930
В.	Code Agencies: Where abbreviations and acronyms are used tract Documents, they shall mean the recognized name of the e Names, telephone numbers, and Web sites are subject to chan rate and up-to-date as of the date of the Contract Documents.	in Specifications or other Con- entities in the following list. ge and are believed to be accu-
IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICC	International Code Council www.iccsafe.org	(888) 422-7233
ICC-ES	ICC Evaluation Service, LLC www.icc-es.org	(800) 423-6587 (562) 699-0543
PART 2 - PR	ODUCTS - NOT USED.	

PART 3 - EXECUTION - NOT USED.

END OF SECTION

REFERENCES

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Temporary Utilities: Electricity, lighting, heat, ventilation, telephone service, water, and sanitary facilities.
- B. Temporary Controls: Barriers, enclosures and fencing, protection of the Work, and water control.
- C. Construction Facilities: Parking, progress cleaning and temporary field offices and storage.
- D. Temporary Fire Protection.
- E. Project Sign.

1.2 GENERAL:

- A. Comply with codes and regulations regarding potable drinking water, sanitation, dust control, fire protection, and other temporary controls.
- B. Interruptions of the utility service to the existing property is not permitted. However, in the event such interruption is needed, obtain written approval from the Owner's Representative a minimum of 72 hours prior to disconnection or shutting off any service or utility. Contractor shall notify Owner of any planned interruption of utilities and services in writing.
- C. Remove all temporary facilities and construction from the site as soon as practical and possible and in the opinion of the Owner's Representative the progress of the work deems it practical.
- D. Restore and refurbish the areas of the site occupied by the temporary facilities to a form acceptable to the Architect and the Owner's Representative.

1.3 TEMPORARY ELECTRICITY:

- A. Cost: By Owner, connect to Owner's existing power service where designated on the drawings.
- B. Do no disrupt Owner's need for continuous service.
- C. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required.
- D. Provide separate generators or other power source for equipment with special power requirements not available from the Owner's service.

1.4 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES:

- A. Provide and maintain lighting for construction operations.
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.

- C. Maintain lighting and provide routine repairs.
- D. Permanent building lighting may be utilized during construction.

1.5 TEMPORARY HEAT:

- A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.
- B. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
- C. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and construction filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.
- 1.6 TEMPORARY COOLING:
 - A. Cost of Energy: By Owner.
 - B. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.
 - C. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
 - D. Prior to operation of permanent equipment for temporary cooling purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.
 - 1. Replace all filters immediately prior to the issuance of the Certificate of Temporary Occupancy.

1.7 TEMPORARY VENTILATION:

A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.8 TELEPHONE SERVICE:

- A. Provide, maintain and pay for telecommunication services to field office at time of project mobilization.
- B. Telecommunications services shall include:
 - 1. Facsimile Service: Minimum of one dedicated fax machine/printer, with dedicated phone line.
 - 2. WIFI connection: High speed/ broad band internet service shall be provided.

1.9 TEMPORARY WATER SERVICE:

- A. Connect to existing water source for construction operations.
- B. Do no disrupt Owner's need for continuous service.

1.10 TEMPORARY SANITARY FACILITIES:

- A. Provide and maintain required facilities and enclosures.
- B. Maintain daily in clean and sanitary condition.
- C. Use of existing facilities is allowed subject to approval of Owner.

1.11 TEMPORARY FIRE PROTECTION:

- A. Provide the required quantity of fire extinguishers, UL labeled ABC all-purpose for protection of the Work.
- B. Provide temporary field office, storage and sheds with required fire extinguishers.
- C. Comply with fire insurance and governing agencies.

1.12 BARRIERS AND TRAFFIC SIGNAGE:

- A. Provide barriers to prevent unauthorized entry to construction areas to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations.
- B. Provide barricades and covered walkways required by governing authorities for public rights-ofway and for access to existing building.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.
- D. Provide temporary traffic control signs to direct construction traffic, staff traffic and public traffic to designated areas during the course of construction.
- E. Design, location, layout and construction of all barricades and cover walkways shall be approved by the Owner prior to construction.

1.13 EXTERIOR ENCLOSURES:

A. Provide temporary weather tight closure of exterior openings in existing buildings to accommodate acceptable working conditions and protection for Products and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.14 INTERIOR ENCLOSURES:

A. Provide temporary partitions and ceilings as required to separate work areas from Owner occupied areas, to prevent penetration of dust and moisture into Owner occupied areas, and to prevent damage to existing materials and equipment.

1.15 PROTECTION OF INSTALLED WORK:

- A. Protect installed Work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

1.16 SECURITY:

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.
- B. Coordinate with Owner's security operations and programs.

1.17 VEHICULAR ACCESS AND PARKING

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Restrict site access and parking to areas designated by the Owner.
- E. Provide means of removing mud from vehicle wheels before entering streets.
- F. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.
- G. Existing parking areas located at _____ may be used for construction parking.

1.18 PROGRESS CLEANING AND WASTE REMOVAL:

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from site weekly at a minimum and more frequently as needed and dispose off-site.
- 1.19 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS:
 - A. Remove temporary utilities, equipment, facilities, materials, prior to Final Application for Payment inspection.
 - B. Clean and repair damage caused by installation or use of temporary work.
 - C. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.20 PROJECT SIGN:

- A. Provide project sign. Sign shall meet UNLV Campus Design and Project Management Standards, available from the UNLV Office of Planning and Construction.
- B. Provide all supports, hardware and other accessories required.

- C. Sign shall be professionally lettered.
- D. Provide drawing of final layout and lettering for approval by Architect and Owner.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION - NOT USED.

END OF SECTION

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. General product requirements.
 - B. Product delivery, storage and handling requirements.
 - C. Existing Products.
 - D. New Products.
 - E. Product options.
 - F. Spare parts and maintenance materials.

1.2 RELATED REQUIREMENTS:

- A. Section 01630 Product Substitutions.
- 1.3 GENERAL PRODUCT REQUIREMENTS:
 - A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.
 - B. All products and material provided shall be new, unused.
- 1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING:
 - A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
 - B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
 - C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent

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PRODUCT REQUIREMENTS

condensation.

- 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
- 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
- 6. Protect stored products from damage and liquids from freezing
- 7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

PART 2 - PRODUCTS

2.1 EXISTING PRODUCTS:

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.
- D. Reused Products: Reused products include materials and equipment previously used in this or other construction, salvaged and refurbished as specified.
- E. Specific Products to be reused: The reuse of certain materials and equipment already existing on the project site is required.
 - 1. See drawings for list of items required to be salvaged for reuse and relocation.
 - 2. If reuse of other existing materials or equipment is desired, submit substitution request.

2.2 NEW PRODUCTS:

- A. Provide new products unless specifically required or permitted by the Contract Documents.
- B. **DO NOT USE** products having any of the following characteristics:
 - 1. Made using or containing CFC's or HCFC's.
 - 2. Made of wood from newly cut old growth timber.
 - 3. Containing lead, cadmium, asbestos.
- C. Where all other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions.
 - 2. If wet-applied, have lower VOC content.
 - 3. Are extracted, harvested, and/or manufactured closer to the location of the project.
 - 4. Have longer documented life span under normal use.
 - 5. Result in less construction waste.
 - 6. Are made of vegetable materials that are rapidly renewable.
 - 7. Are made of recycled materials.
 - 8. If made of wood, are made of sustainably harvested wood, wood chips, or wood fiber.
 - 9. If bio-based, other than wood, are or are made of Sustainable Agriculture Network certified products.
- D. Provide interchangeable components of the same manufacture for components being replaced.
- E. Motors: Refer to Electrical Drawings, NEMA MG 1 Type. Specific motor type is specified in

PRODUCT REQUIREMENTS

individual specification sections.

- F. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Size terminal lugs to NFPA 70, include lugs for terminal box.
- G. Cord and Plug: Provide minimum 6 foot cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual specification sections.

2.3 PRODUCT OPTIONS:

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 - 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Products specified by stating that the Contract Documents are based on a Product by a single manufacturer followed by the statement "Equivalent products by the following manufacturers are acceptable":
 - 1. Select the specified Product or a Product by a named manufacturer having equivalent or superior characteristics to the specified Product and meeting the requirements of the Contract Documents.
 - 2. If the specified Product is not selected, submit Product Data to substantiate compliance of proposed Product with specified requirements.
 - 3. The specified Product establishes the required standard of quality.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Article 3.01 of this Specification.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- E. Products specified by naming one Product followed by the statement "Substitutions: Not permitted": Substitutions will not be allowed.
- F. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
 - 1. Select any Product meeting the specified standard.
 - 2. Submit Product Data to substantiate compliance of proposed Product with specified

PRODUCT REQUIREMENTS

requirements.

- G. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- H. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.
- I. Products specified by required performance or attributes, without naming a manufacturer or Product:
 - 1. Select any Product meeting specified requirements.
 - 2. Submit Product Data to substantiate compliance of proposed Product with specified requirements.

2.4 SPARE PARTS AND MAINTENANCE MATERIALS:

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site and by the Contractor; obtain receipt prior to final payment.

PART 3 - EXECUTION

- 3.1 SUBSTITUTION PROCEDURES REFER TO SECTION 01630 PRODUCT SUBSTITUTIONS.
- 3.2 OWNER-FURNISHED PRODUCTS:
 - A. Refer to Section 01420 References for specific requirements for:
 - 1. OWNER FURNISHED OWNER INSTALLED (OFOI) products.
 - 2. OWNER FURNISHED CONTRACTOR INSTALLED (OFCI) products.
 - B. Owner's Responsibilities:
 - 1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
 - 2. Arrange and pay for product delivery to site.
 - 3. On delivery, inspect products jointly with Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 5. Arrange for manufacturers' warranties, inspections, and service.
 - C. Contactor's Responsibilities:
 - 1. Contractor shall provide a written schedule to the Owner indicating when the Owner Furnished items must be received at the project site to insure the Project completion in accordance with the established schedule. Such dates shall be shown on the schedule.
 - 2. Review Owner reviewed shop drawings, product data, and samples.
 - 3. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
 - 4. Handle, store, install and finish products.
 - 5. Repair or replace items damaged after receipt.

3.3 TRANSPORTATION AND HANDLING:

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.4 STORAGE AND PROTECTION:

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels visible, intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- H. Comply with manufacturer's warranty conditions, if any.
- I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- J. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- K. Prevent contact with material that may cause corrosion, discoloration, or staining.
- L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- M. Arrange storage of products to permit access for inspection. Periodically inspect to verify

PRODUCT REQUIREMENTS

products are undamaged and are maintained in acceptable condition.

END OF SECTION

PRODUCT REQUIREMENTS

SECTION 01630

PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Administrative and procedural requirements for substitutions.
- 1.2 RELATED SECTIONS:
 - A. Section 01330 Submittals Procedures.
 - B. Section 01600 Product Requirements: for requirements for submitting comparable product submittals for products by listed manufacturers.
 - C. Section 01700 Execution Requirements.

1.3 DEFINITIONS:

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

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form provided in Project Manual.
- C. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - 1. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - 2. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate Contractors that will be necessary to accommodate proposed substitution.
 - 3. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
- D. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

PRODUCT SUBSTITUTIONS

- E. Samples, where applicable or requested.
- F. Certificates and qualification data, where applicable or requested.
- G. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
- H. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
- I. Research reports evidencing compliance with building code in effect for Project, and applicable code organization.
- J. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
- K. Cost information, including a proposal of change, if any, in the Contract Sum.
- L. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
- M. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

1.5 QUALITY ASSURANCE:

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

1.6 PROCEDURES:

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

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS:

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 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.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction

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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: Architect will consider requests for substitution if received within 30 days after the Notice of Award. 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. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
 - b. 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.
 - c. Requested substitution does not require extensive revisions to the Contract Documents.
 - d. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - e. Substitution request is fully documented and properly submitted.
 - f. Requested substitution will not adversely affect Contractor's construction schedule.
 - g. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - h. Requested substitution is compatible with other portions of the Work.
 - i. Requested substitution has been coordinated with other portions of the Work.
 - j. Requested substitution provides specified warranty.
 - k. 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.

PART 3 - EXECUTION

3.1 SUBSTITUTION SUBMITTAL PROCEDURES:

- A. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- B. Substitution request must be completed with all required information. Incomplete substitution requests will be returned with no action taken.
- C. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

- D. Submit 1 copy (electronic) of request for substitution for consideration. Limit each request to one proposed substitution.
- E. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
- F. Substitution request does not replace the required submittal. Submittals for any items accepted through the Substitution Request procedure are still required.

3.2 ARCHITECTS ACTION:

- A. If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution.
- B. Architect will notify Contractor of acceptance or rejection of proposed substitution within:
 - 1. 14 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
- C. Forms of Acceptance:
 - 1. Architect's Supplemental Instructions for minor changes in the Work.
 - 2. Construction Change Directive:
 - a. Architect may issue a directive, signed by Owner, instructing Contractor to proceed with a change for subsequent inclusion in a Change Order.
 - b. Documentation will describe changes in Work and designate method of determining any change to Contract Sum or Contract Time. Promptly execute change.
 - 3. Change Orders:
 - a. AIA Document G701
- D. The Architect will notify Contractor in writing of decision to accept or reject request.

END OF SECTION

SECTION 01700

EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. General procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. General installation of products.
 - 3. Progress cleaning.
 - 4. Starting and adjusting.
 - 5. Protecting installed construction.
 - 6. Correction of the Work.
 - 7. Adjustment of the Work
 - 8. General requirements for maintenance service.

1.2 RELATED REQUIREMENTS:

- A. Section 01045 Cutting and Patching:
- B. Section 01732 Selective Demolition:
- C. Section 01770 Closeout Procedures: Final Cleaning.

1.3 PROJECT CONDITIONS

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- B. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
 - 1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
 - 2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.
- C. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
 - 1. At All Times: Excessively noisy tools and operations will not be tolerated inside the building at any time of day; excessively noisy includes jackhammers.
 - 2. Outdoors: Limit conduct of noisy exterior work to hours approved by the Owner's Representative.
 - 3. Indoors: Limit conduct of noisy interior work to hours approved by the Owner's Representative.

1.4 COORDINATION:

- A. Verify all dimensions and conditions at the site.
- B. Coordinate the Work of this section with all trades.

- C. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- D. Notify affected utility companies and comply with their requirements.
- E. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- F. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- G. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- H. Coordinate completion and clean-up of work of separate sections.
- I. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.
- J. All work, including materials and workmanship, shall conform to the requirements of applicable local codes, laws, ordinances, the adopted building codes, ANSI A117.1 Guidelines for Accessible & Useable Buildings and Facilities, and ADAAG- ADA Accessibility Guidelines for Buildings & Facilities.

PART 2 - PRODUCTS

2.1 MATERIALS:

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
- B. Before construction, verify the location and points of connection of utility services.
- C. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

- 1. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- D. Acceptance of Conditions:
 - 1. 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. Start of work means acceptance of existing conditions.
 - 2. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.
- E. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- F. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- G. Examine and verify specific conditions described in individual specification sections.
- H. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- I. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
- J. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.
- K. Notify Owner and Architect of discrepancies prior to commencement of Work.

3.2 CONSTRUCTION LAYOUT:

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
 - 7. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
 - 8. 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.

EXECUTION REQUIREMENTS

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

3.3 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - 4. Site: Maintain Project site free of waste materials and debris.
 - 5. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - a. Remove liquid spills promptly.
 - b. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
 - 6. 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.
 - 7. Concealed Spaces: Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
 - 8. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
 - 9. 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.
 - 10. 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.
 - 11. Limiting Exposures: Supervise construction operations to assure that no part of the construction completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
 - 12. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.4 STARTING AND ADJUSTING:

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION OF INSTALLED WORK:

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

3.6 CORRECTION OF THE WORK:

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Section 01045 - Cutting and Patching.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
 - 2. Restore permanent facilities used during construction to their specified condition.
 - 3. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
 - 4. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
 - 5. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

3.7 DEMONSTRATION AND INSTRUCTION:

A. See Section 01820 - Demonstration and Training.

3.8 ADJUSTING:

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.
- B. Testing, adjusting, and balancing HVAC systems: Refer to Drawings.

3.9 MAINTENANCE:

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty; whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

EXECUTION REQUIREMENTS

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SECTION 01732

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. The extent of selective demolition/removal work required is shown by notes and graphic information on the drawings, and may be summarized, but not by way of limitation, as the removal of existing assemblies from the building interior, the removal of existing mechanical and electrical systems (to the extent indicated), the removal of existing construction (to the extent indicated) from the building and removal work at existing adjacent construction, as necessary to receive or provide for new construction.
 - 1. Note that while the Drawings show the intent of the scope of demolition work, the Contractor shall review the scope and identify to himself or herself the full extent of the demolition work and associated work to be included in the scope to fully execute the design and contract documents.
- B. Salvage of Owner-designated materials and equipment.

1.2 RELATED REQUIREMENTS:

A. Section 01045 - Cutting and Patching.

1.3 REGULATORY REQUIREMENTS:

- A. Conform to local codes and ordinances for demolition of construction, safety of adjacent structures, dust control, runoff control and disposal.
- B. Obtain required permits from authorities.
- C. Notify affected utility companies before starting work and comply with their requirements.
- D. Do not obstruct roadways, sidewalks, hydrants without permits from governing agencies and with written approval from the Owner.
- E. If hazardous or contaminated materials are encountered, comply with the requirements of the Special Conditions.

1.4 SCHEDULING:

- A. Schedule demolition work to coincide with new construction.
- B. Schedule work to minimize disruption of access to and activities within the existing facilities.
- C. Provide work plan to indicate proposed methods to complete demolition requirements in accordance with proposed schedule.
- D. Demolition schedule and work plan shall be approved by Owner prior to start of any demolition work.
- E. Do not disable or disrupt building security, fire or life safety systems without 3 days prior written notice to Owner.

1.5 PREDEMOLITION MEETINGS:

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

1.6 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Submit schedule and work plan for demolition operations to Owner for approval prior to any Work of this section.
- C. Indicate proposed methods and sequence of operations. Include coordination for shut-off, capping, and continuation of utility services as required, together with details for dust and noise control protection.
- D. Indicate site access routes to and from project site for equipment access and removal of materials for off-site disposal.
- E. Include method of covering or enclosing demolition debris to protect existing construction and finishes.

1.7 QUALITY ASSURANCE:

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
 1. Minimum of 10 years of documented experience.
- B. Permits and Licenses: Contractor shall obtain all necessary permits and licenses for performing the Work and shall furnish a copy of same to the County prior to commencing the Work. The Contractor shall comply with the requirements of the permits
- C. Notices: Contractor shall issue written notices of planned demolition to companies or local authorities owning utility conduit, wires, or pipes running to or through the project site. Copies of said notices shall be submitted to the County.
- D. Utility Services: Contractor shall notify utility companies or local authorities furnishing gas, water, electrical, telephone, or sewer service to remove any equipment in the structures to be demolished and to remove, disconnect, cap, or plug their services to facilitate demolition.
- E. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- F. The Contractor shall comply with the requirements of applicable Federal and State regulations regarding the demolition of structures including ANSI/ NFPA 251 Building Construction and Demolition Operations and ANSI 10.2 Safety Code, ANSI 10.6 Safety Requirements for Demolition.

1.8 PROJECT CONDITIONS:

- A. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- B. Protections: Ensure safe passage of persons around area of demolition. Conduct operations to prevent damage to adjacent buildings, structures, and other facilities and injury to persons.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
 - 2. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and Architect.
 - 3. Provide shoring, bracing, or support to prevent movement, settlement, or collapse of structure or other work to remain.
 - 4. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
 - 5. Protect floors with suitable coverings when necessary.
- C. Damages: Promptly repair damages caused to adjacent tenant spaces by demolition work as directed by the Architect at no cost to Owner.
- D. Owner assumes no responsibility for condition of areas to be selectively demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- E. 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.
- F. Hazardous Materials:
 - 1. Asbestos Containing Materials (ACM):
 - a. It is not expected that asbestos hazardous materials will be encountered in the Work. If constructions suspected of containing Asbestos Containing Materials (ACM) are encountered, do not disturb; immediately notify Architect and Owner. ACM materials will be removed by Owner under a separate contract.
 - 2. Lead Containing Paint:
 - a. It is not expected that lead containing paint is present. If constructions suspected of containing lead containing paint are encountered, do not disturb; immediately notify Architect and Owner. ACM materials will be removed by Owner under a separate contract.
 - 3. Other Hazardous Materials:
 - a. The existing fire exit signs, fire alarm lights, emergency lights, fluorescent lights, may have the potential to contain hazardous materials such as Polychlorinated Biphenyls (PCBs), Mercury (halide) filaments, batteries and/or radioactive material (tritium).
 - b. The Contractor is responsible for removing, transporting, and legal disposal in a landfill designated for these hazardous materials

PART 2 - PRODUCTS - NOT USED.

- 2.1 MATERIALS:
 - A. Carefully remove salvageable items such as light fixtures, grilles, doors, hardware, plumbing fixtures, and other items which are not specifically indicated for reuse, but which may have salvage value to the Owner.
 - 1. Demolished materials and equipment shall be stockpiled in an area designated by the

Owner, in a manner that the Owner may determine those items which have salvage value to the Owner.

- 2. Those materials, which are not salvaged by the Owner, shall become the possession of the Contractor and shall be immediately removed from the site.
- B. Carefully remove materials (in whole or in part as required) that are scheduled for reuse. Store and protect for reinstallation the materials identified by the owner.

PART 3 - EXECUTION

3.1 SCOPE:

- A. Remove other items indicated, for salvage, relocation, recycling, and re-use as shown in the Drawings.
 - 1. Refer to Mechanical and Plumbing Drawings for demolishing, cutting, patching, or relocating plumbing and mechanical items.
 - 2. Refer to Electrical Drawings for demolishing, cutting, patching, or relocating electrical items.

3.2 EXAMINATION:

- A. Existing Facilities: Protect existing facilities and structures designated to remain, temporarily or permanently, from damage during demolition or construction activities'. Repair items damaged during demolition or construction activities to their original condition, or replace with new. Do not overload structural elements or pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition and/or removal work. Repairs, reinforcement or structural replacement shall be approved by Architect or Owner's Representative.
- B. When unanticipated mechanical, electrical, or structural elements that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the Architect.

3.3 PREPARATION:

- A. Notify affected utility companies before starting work and comply with their requirements.
 1. Mark location of utilities.
 - 2. Identify, disconnect, remove and cap designated utilities within demolition areas.
- B. Provide, erect, and maintain temporary barriers and security devices where required and as indicated on drawings.
- C. Protect existing landscaping materials, appurtenances, and structures which are not to be demolished.
- D. Protect benchmarks and existing work from damage or displacement.
- E. Prevent movement or settlement of adjacent structures.
- F. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon or limit access to their property.
- G. Protection of existing building exterior:
 - 1. Erect weatherproof closures for exterior openings. Maintain exit requirements.

- 2. Protect from weather openings cut in existing roof for new work, or where existing roofing is removed to allow new construction to join existing.
- 3. Install temporary deck of exterior grade plywood and wood skids, or other material approved by Architect, for material and personnel traffic over existing roofing, to protect existing roof and surrounding surfaces from damage. Repair damage caused to the roof and other items.
- H. Dustproof Partitions:
 - 1. Erect and maintain as required to prevent spread of dust, fumes and smoke to other parts of the building.
 - 2. On completion, remove partitions and repair damage surfaces to match adjacent surfaces.
- I. Roofing Removal: During the removal of the existing parapets and roofing, provide proper protection from falling objects. Maintain interior of building rain and water protection.

3.4 GENERAL PROCEDURES AND PROJECT CONDITIONS:

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. 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 fire watch and portable fire suppression devices during flame cutting operations.
 - a. Maintain adequate ventilation when using cutting torches.
 - b. Wherever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. Instruct all possible users in use of fire extinguishers.
 - c. Keep hydrants clear and accessible at all times. Prohibit debris from accumulating within a radius of 4500 mm (15 feet) of fire hydrants.
 - 5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of offsite.
 - 6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - 7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 8. Dispose of demolished items and materials promptly.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Use of explosives is not permitted.
 - 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of

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unstable structures.

- 5. Provide, erect, and maintain temporary barriers and security devices.
- 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
- 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
- 8. Do not close or obstruct roadways or sidewalks without permit.
- 9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
- 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- C. Do not begin removal until receipt of notification to proceed from Owner.
- D. Do not begin removal until built elements to be salvaged or relocated have been removed.
- E. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- H. Perform demolition in a manner that maximizes salvage and recycling of materials.
 - 1. Dismantle existing construction and separate materials.
 - 2. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

3.5 EXISTING UTILITIES:

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.6 SELECTIVE DEMOLITION FOR ALTERATIONS:

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as shown.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
 - 2. Provide sound retardant partitions of construction indicated on drawings in locations indicated on drawings.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- D. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 07 01 50 Preparation for Re-Roofing for new roofing requirements.
 - 1. Remove existing roof membrane, flashings, copings, and roof accessories.
 - 2. Remove existing roofing system down to substrate.
- E. E. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
 - 2. Remove items indicated on drawings.
- F. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and Security): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Verify that abandoned services serve only abandoned facilities before removal.
 - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- G. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off indicated utilities with utility companies.
 - 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.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated 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.
- 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, an d 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.
- H. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.
- I. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.

3.7 PATCHING AND REPAIRS:

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching and Repairs: Comply with Section 01045 Cutting and Patching.
 - 1. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
 - 2. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.
- C. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.
- D. Floors and Walls: Where walls or partitions that are demolished 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 existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
- E. Ceilings: Patch, repair, or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.8 DEBRIS AND WASTE REMOVAL:

- 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.
- B. Remove debris, junk, and trash from site.
- C. Remove from site all materials not to be reused on site; do not burn or bury.

- D. Leave site in clean condition, ready for subsequent work.
- E. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 01770

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Administrative and procedural requirements for contract closeout, including, but not limited to, the following: (as part of Set of Manuals & Documents for Commissioning process) Inspection procedures including Pre-Functional Checklists and Pre-Substantial Checklists.
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.

1.2 RELATED REQUIREMENTS:

- A. Section 01322 Photographic Documentation: for submitting final completion construction photographic documentation.
- B. Section 01700 Execution Requirements: for progress cleaning of Project site.
- C. Section 01781 Project Record Documents: for submitting record Drawings, record Specifications, and record Product Data.
- D. Section 01782 Operation and Maintenance Data: for operation and maintenance manual requirements.
- E. Section 01820 Demonstration and Training: for requirements for instructing Owner's personnel.

1.3 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements
- B. Product Data: For cleaning agents.
- C. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- D. Certified List of Incomplete Items: Final submittal at Final Completion.
- E. Certificates of Release: From authorities having jurisdiction.
- F. Certificate of Insurance: For continuing coverage.
- G. Field Report: For pest control inspection.
- H. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.
- 1.4 SUBSTANTIAL COMPLETION PROCEDURES:
 - A. Definition: Substantial Completion is that condition which occurs when the Owner accepts the

certification of the Architect that construction is sufficiently complete in accordance with the Contract Documents so that the Project may be occupied for the use for which it is intended.

- B. Contractor Notification: When Contractor considers work substantially complete, and after the building commissioning and training, submit written declaration to the Architect that Work or designated portion thereof, is substantially complete. Include list of items to be completed or corrected.
- C. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
 - 1. Prepare a list of items to be completed and corrected (Contractor's punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Advise Owner of pending insurance changeover requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 5. 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.
 - 6. Prepare and submit: Completed Commissioning Manual including but not limited to -Summary by specification # Record of Approved Submittals and Samples, Project Record Documents (including but not limited to As-Built Record Drawings, As-Built Record Specifications, Operating and Maintenance Manuals, Certification of No Asbestos Products Incorporated in Project, Completed Punch Lists, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 8. Complete startup testing of systems.
 - 9. Submit test/adjust/balance records and Specification compliant Final Report.
 - 10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 11. Advise Owner of changeover in heat and other utilities.
 - 12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 - 13. Complete final cleaning requirements, including touchup painting.
 - 14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
 - 15. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
 - 16. Prior to preliminary Substantial Completion and Inspection Submit:
 - a. Operating and Maintenance Data
 - b. Keys and keying schedule
 - c. Guarantees, Warranties and Bonds
 - d. Completed pre-substantial completion checklists
- D. Preliminary Inspection: Architect will make a preliminary inspection within 7 business days after receipt of Contractor's declaration.
- E. Submit a written request for inspection for Substantial Completion. Upon receipt of request, Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion A.I.A. Document G704 or similar, after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

- 1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
- 2. Results of completed inspection will form the basis of requirements for final completion.
- F. Upon determining that Work is substantially complete, Architect will:
 - 1. Punch List: Prepare a punch list of items to be completed or corrected, as determined by the inspection.
 - 2. 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.
 - a. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 - b. Include the following information at the top of each page:
 - 1) Project name.
 - 2) Date.
 - 3) Name of Architect and Construction Manager.
 - 4) Name of Contractor.
 - 5) Page number.
 - Submit list of incomplete items in the following format:
 - 1) PDF electronic file.
 - 3. Certificate: Prepare and process a certificate of substantial completion, containing:
 - a. Date of substantial completion.
 - b. Punchlist of items to be completed or corrected.
 - c. The time within which punchlist items shall be completed or corrected.
 - d. Date and time the Owner will take occupancy of Project or designated portion thereof.
 - e. Responsibilities of Owner and Contractor for:
 - 1) Insurance.
 - 2) Utilities.
 - 3) Operation and maintenance of mechanical, electrical and other systems.
 - 4) Maintenance and cleaning.
 - 5) Security.
 - f. Signatures of:
 - 1) Architect.
 - 2) General Contractor.
 - 3) Owner.
- G. Contractor is responsible for the following:
 - 1. Corrections: Complete all Work listed for completion or correction within designated time.
 - 2. Final Cleaning: Perform final cleaning.
- H. Occupancy: Using Agency will occupy Project or designated portions thereof under provisions stated in the Certificate of Substantial Completion.
- I. Complete All Work: At time of inspection, should substantial completion not be certified, Contractor shall complete the Work and resubmit declaration in accordance with the requirements of this Section.
- 1.5 FINAL COMPLETION PROCEDURES:

C.

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
 - 1. Submit a final Application for Payment according to Section 01290 Payment Procedures.
 - 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed

and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

- Certificate of Insurance: Submit evidence of final, continuing insurance coverage 3. complying with insurance requirements.
- Submit pest-control final inspection report. 4.
- Β. 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.
 - Reinspection: Request reinspection when the Work identified in previous inspections as 1. incomplete is completed or corrected.

1.6 LIST OF INCOMPLETE ITEMS (PUNCH LIST):

- Organization of List: Include name and identification of each space and area affected by Α. construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction
 - Organize list of spaces in sequential order, starting with exterior areas first and 1. proceeding from lowest floor to highest floor.
 - Organize items applying to each space by major element, including categories for ceiling, 2. individual walls, floors, equipment, and building systems. 3.
 - Include the following information at the top of each page:
 - Project name. a.
 - b. Date.
 - Name of Architect. c.
 - Name of Contractor. d.
 - Page number. e.
 - 4. Submit list of incomplete items in the following format:
 - MS Excel electronic file. Architect, will return annotated file. a.
 - PDF electronic file. Architect will return annotated file. b.
 - Three paper copies. Architect will return two copies. C.

1.7 SUBMITTAL OF PROJECT WARRANTIES:

- Α. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- Β. Partial Occupancy: Submit properly executed warranties within [15] days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - Identify each binder on the front and spine with the typed or printed title "WARRANTIES." 3. Project name, and name of Contractor.
 - 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty

and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

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

PART 2 - PRODUCTS

2.1 MATERIALS:

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

PART 3 - EXECUTION

3.1 FINAL CLEANING:

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - 2. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - 3. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - 4. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - Remove tools, construction equipment, machinery, and surplus material from Project site.
 Remove snow and ice to provide safe access to building.
 - 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.
 - 8. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - 9. Sweep concrete floors broom clean in unoccupied spaces.
 - 10. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - 11. 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.
 - 12. Remove labels that are not permanent.
 - 13. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - 14. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - 15. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of

diffusers, registers, and grills.

- 16. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
- 17. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
- 18. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 01500 Construction Facilities and Temporary Controls.

3.2 REPAIR OF THE WORK:

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

END OF SECTION 01770

SECTION 01781

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Administrative and procedural requirements for project record documents, including the following:
 1. Record Drawings.
 - Record Drawings.
 Record Specification
 - Record Specifications.
 Record Product Data.
 - Record Product Data.
 Miscellaneous record submittals.
- 1.2 RELATED REQUIREMENTS:
 - A. Section 01700 Execution Requirements: for final property survey.
 - B. Section 01770 Closeout Procedures: for general closeout procedures.
 - C. Section 01782 Operation and Maintenance Data: for operation and maintenance manual requirements.
- 1.3 CLOSEOUT SUBMITTALS:
 - A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
 - B. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit **one** set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit **one** paper-copy set(s) of marked-up record prints.
 - 2) Submit PDF electronic files of scanned record prints and **one** of file prints.
 - 3) Submit record digital data files and **one** set(s) of plots.
 - 4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit **three** paper-copy set(s) of marked-up record prints.
 - Submit PDF electronic files of scanned record prints and three set(s) of prints.
 - 3. Print each drawing, whether or not changes and additional information were recorded.
 - a. Final Submittal:
 - 1) Submit **one** paper-copy set(s) of marked-up record prints.
 - 2) Submit record digital data files and **three** set(s) of record digital data file plots.
 - 3) Plot each drawing file, whether or not changes and additional information were recorded.
 - C. Record Specifications: Submit **annotated PDF electronic files** of Project's Specifications, including addenda and contract modifications.
 - D. Record Product Data: Submit **annotated PDF electronic files and directories** of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals,

PROJECT RECORD DOCUMENTS

submit duplicate marked-up Product Data as a component of manual.

- E. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous recordkeeping requirements and submittals in connection with various construction activities. Submit **annotated PDF electronic files and directories** of each submittal.
- F. 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.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS:

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

- 1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
- 2. Format: [DWG] [DXF] [DGN], Version Microsoft Windows operating system.
- 3. Format: Annotated PDF electronic file with comment function enabled.
- 4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
- 5. Refer instances of uncertainty to Architect for resolution.
- 6. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 01330 "Submittal Procedures" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
 - 1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
 - 2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Format: Annotated PDF electronic file **with comment function enabled**.
 - 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 - 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS:

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

file(s) of marked-up paper copy of Specifications.

2.3 RECORD PRODUCT DATA:

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Order, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as annotated PDF electronic file, scanned PDF electronic file(s) of marked-up paper copy of Product Data.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.
- 2.4 MISCELLANEOUS RECORD SUBMITTALS:
 - A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
 - B. Format: Submit miscellaneous record submittals as PDF electronic file, scanned PDF electronic file(s) of marked-up miscellaneous record submittals.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE:

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

END OF SECTION

SECTION 01782

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.

1.2 RELATED REQUIREMENTS:

- A. Section 01330 Submittal Procedures: for submitting copies of submittals for operation and maintenance manuals.
- B. Section 01810 General Commissioning Requirements: for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS:

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

1.4 CLOSEOUT SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect **and Commissioning Authority** will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- C. Format: Submit operations and maintenance manuals in the following format:
 - PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
 - 2. **Three** paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return [**two**] copies.
- D. Initial Manual Submittal: Submit draft copy of each manual at least [**30**] days before commencing demonstration and training. Architect will comment on whether general scope and

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content of manual are acceptable.

- E. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least [15] days before commencing demonstration and training. Architect **and Commissioning Authority** will return copy with comments.
 - Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within [15] days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

- 2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY:
 - A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 - 1. List of documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 4. Table of contents.
 - B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 - C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
 - D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
 - E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS:

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

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- 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
- 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Enable bookmarking of 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.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, **and** subject matter of contents, **and indicate Specification Section number on bottom of spine**. Indicate volume number for multiple-volume sets.
 - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 - 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
 - 4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) white bond paper.
 - 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS:

- A. Content: Organize manual into a separate section for each of the following:
 - 1. Type of emergency.
 - 2. Emergency instructions.
 - 3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 - 1. Fire.
 - 2. Flood.
 - 3. Gas leak.
 - 4. Water leak.
 - 5. Power failure.
 - 6. Water outage.
 - 7. System, subsystem, or equipment failure.
 - 8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:
 - 1. Instructions on stopping.
 - 2. Shutdown instructions for each type of emergency.
 - 3. Operating instructions for conditions outside normal operating limits.
 - 4. Required sequences for electric or electronic systems.
 - 5. Special operating instructions and procedures.

2.4 OPERATION MANUALS:

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions. 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.
- B. 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.

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- C. Operating Procedures: Include the following, as applicable:
 - 1. Startup procedures.
 - 2. Equipment or system break-in procedures.
 - 3. Routine and normal operating instructions.
 - 4. Regulation and control procedures.
 - 5. Instructions on stopping.
 - 6. Normal shutdown instructions.
 - 7. Seasonal and weekend operating instructions.
 - 8. Required sequences for electric or electronic systems.
 - 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.
- 2.5 PRODUCT MAINTENANCE MANUALS:
 - A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
 - B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
 - C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
 - D. Maintenance Procedures: Include manufacturer's written recommendations and the following: 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
 - E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
 - F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS:

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION:

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care

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and maintenance of each product, material, and finish incorporated into the Work.

- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared record Drawings in Section 01781 -Project Record Documents.
- G. Comply with Section 01770 Closeout Procedures, for schedule for submitting operation and maintenance documentation.

END OF SECTION 01782

SECTION 01810

GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS:
 - A. OPR and BoD documentation are included by reference for information only.
- 1.2 SECTION INCLUDES:
 - A. General requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- 1.3 RELATED SECTIONS:
 - A. Section 01815 Commissioning of HVAC: for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.

1.4 DEFINITIONS:

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

1.5 COMMISSIONING TEAM:

- A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of **each** Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by Owner:
 - 1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
 - 2. Representatives of the facility user and operation and maintenance personnel.

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3. Architect and engineering design professionals.

1.6 OWNER'S RESPONSIBILITIES:

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

1.7 **EACH** CONTRACTOR'S RESPONSIBILITIES:

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

1.8 CxA'S RESPONSIBILITIES:

- A. Organize and lead the commissioning team.
- B. Provide commissioning plan.
- C. Convene commissioning team meetings.
- D. Provide Project-specific construction checklists and commissioning process test procedures.
- E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.
- F. Prepare and maintain the Issues Log.
- G. Prepare and maintain completed construction checklist log.
- H. Witness systems, assemblies, equipment, and component startup.
- I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

GENERAL COMMISSIONING REQUIREMENTS

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION - NOT USED.

END OF SECTION

SECTION 01815

COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Commissioning process requirements for HVAC&R systems, assemblies, and equipment.
- 1.2 RELATED SECTIONS:
 - A. Section 01810 General Commissioning Requirements: for general commissioning process requirements.
 - B. Section 15945 Building Commissioning.

1.3 DEFINITIONS:

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS:

- A. Certificates of readiness.
- B. Certificates of completion of installation, prestart, and startup activities.

1.5 ALLOWANCES:

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Section 01210 - Allowances.

1.6 CONTRACTOR'S RESPONSIBILITIES:

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.
- C. Attend testing, adjusting, and balancing review and coordination meeting.
- D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.

COMMISSIONING OF HVAC

- F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- 1.7 CxA'S RESPONSIBILITIES:
 - A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
 - B. Direct commissioning testing.
 - C. Verify testing, adjusting, and balancing of Work are complete.
 - D. Provide test data, inspection reports, and certificates in Systems Manual.

1.8 COMMISSIONING DOCUMENTATION:

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
 - 5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
 - 6. Test and inspection reports and certificates.
 - 7. Corrective action documents.
 - 8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

- 3.1 TESTING PREPARATION:
 - A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
 - B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
 - C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
 - D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 Testing AND BALANCING VERIFICATION:

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least **[10]** days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
 - 1. The CxA will notify testing and balancing [**Contractor**] [**Subcontractor**] [**10**] days in advance of the date of field verification. Notice will not include data points to be verified.
 - 2. The testing and balancing [**Contractor**] [**Subcontractor**] shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
 - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS:

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA along with the HVAC&R [Contractor] [Subcontractor], testing and balancing [Contractor] [Subcontractor], and HVAC&R Instrumentation and Control [Contractor] [Subcontractor] shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments.
 Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal

operating conditions.

- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.
- 3.4 HVAC&R systems, subsystems, and equipment Testing Procedures:
 - A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in HVAC boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.
 - B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 15.
 - C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R [**Contractor**] [**Subcontractor**] shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
 - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
 - 2. Description of equipment for flushing operations.
 - 3. Minimum flushing water velocity.
 - 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
 - D. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
 - E. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
 - F. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION

SECTION 01820

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

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

1.2 RELATED REQUIREMENTS:

A. Section 01770 - Closeout Procedures.

1.3 NFORMATIONAL SUBMITTALS:

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

1.4 CLOSEOUT SUBMITTALS:

- A. Demonstration and Training Video Recordings: Submit **two** copies within **seven** days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
 - 2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
 - 3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video

recording on each page.

4. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals and in PDF electronic file format on compact disc.

1.5 QUALITY ASSURANCE:

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01400 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01310 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION:

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

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM:

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

 Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - Basis of System Design, Operational Requirements, and Criteria: Include the following: a. System, subsystem, and equipment descriptions.

- b. Performance and design criteria if Contractor is delegated design responsibility.
- c. Operating standards.
- d. Regulatory requirements.
- e. Equipment function.
- f. Operating characteristics.
- g. Limiting conditions.
- h. Performance curves.
- 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
- 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - I. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
 - Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly

5.

instructions.

- d. Instructions for identifying parts and components.
- e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01782 Operation and Maintenance Data.
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION:

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Architect with at least seven (7) days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written performance-based test.
- F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS:

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.
 - 1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.

- 2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
- 3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
- 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. E-mail address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 1. Film training session(s) in segments not to exceed 15 minutes.
 - Film training session(s) in segments not to exceed 15 minutes. a. Produce segments to present a single significant piece of equipment per
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 - 1. Furnish additional portable lighting as required.
- E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- F. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION

SECTION 03010

MAINTENANCE OF CONCRETE

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Cleaning of existing concrete surfaces.
 - B. Repair of exposed structural, shrinkage, and settlement cracks.
 - C. Resurfacing of concrete surfaces having spalled areas and other damage.
 - D. Repair of deteriorated concrete.
- 1.2 RELATED REQUIREMENTS:
 - A. Section 09056 Common Work Results for Flooring Preparation.

1.3 REFERENCE STANDARDS:

- A. ASTM C33/C33M Standard Specification for Concrete Aggregates; 2013.
- B. ASTM C39/C39M Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2014.
- C. ASTM C109/C109M Standard Test Method for Compressive Strength of Hydraulic Cement Mortars; (Using 2 inch (50 mm) cube specimens); 2013.
- D. ASTM C150/C150M Standard Specification for Portland Cement; 2012.
- E. ASTM C404 Standard Specification for Aggregates for Masonry Grout; 2011.
- F. ASTM C881/C881M Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2013.
- G. ASTM C928/C928M Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Material for Concrete Repairs; 2013.
- H. ASTM C1059/C1059M Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2013.
- I. AWS D1.4/D1.4M Structural Welding Code Reinforcing Steel; American Welding Society; 2011.
- 1.4 DESIGN REQUIREMENTS:
 - A. Extend existing control or constructions joints through the patching mortar.
 - B. Do not bridge moving cracks.
 - C. Follow manufacturer's recommendations with mixing requirements ensuring no addition of any type of admixtures or concrete modifiers.

- D. Featheredging the repair will result in reduced durability and performance.
- E. Ensure the length-to-width ratio of the patch does not exceed 2:1.

1.5 SUBMITTALS:

- A. See Section 01330 Submittal Requirements, for submittal procedures.
- B. Product Data: Indicate product standards, physical and chemical characteristics, technical specifications, limitations, maintenance instructions, and general recommendations regarding each material.
 - 1. Material Safety Data Sheets (MSDS)
- C. Qualification Statements.
- D. Project Record Documents: Accurately record actual locations of structural reinforcement repairs and type of repair.

1.6 QUALITY ASSURANCE:

- A. Designer Qualifications: Design reinforcement splices under direct supervision of a Professional Structural Engineer experienced in design of this type of work and licensed in the State of Nevada.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than Ten (10) years of documented experience.
- C. Cleaner Qualifications: Company specializing in, and with minimum of five (5) years of experience in, the type of cleaning specified.
- D. Installer Qualifications: Company specializing in performing work of the type specified and with minimum of five (5) years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING:

A. Comply with manufacturers' instructions for storage, shelf life limitations, and handling of products.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS:

- A. Degreaser:
 - 1. Products:
 - a. L&M Construction Chemicals, Inc., a subsidiary of Laticrete International, Inc.; CITREX: <u>www.lmcc.com</u>.
 - b. SpecChem, LLC; Citrus Cleaner: <u>www.specchemllc.com</u>.
 - c. W.R. Meadows, Inc.; Ultrite Degreaser: <u>www.wrmeadows.com</u>.
- B. Detergent: Non-ionic detergent.
- 2.2 CEMENTITIOUS PATCHING AND REPAIR MATERIALS:
 - A. Manufacturers:

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- 1. ARDEX Engineered Cements: <u>www.ardexamericas.com</u>.
- 2. The QUIKRETE Companies: <u>www.quikrete.com</u>.
- 3. W.R. Meadows, Inc.: <u>www.wrmeadows.com</u>.
- B. Bonding Slurry: Water-based latex admixture complying with ASTM C1059/C1059M, combined with Portland cement and sand in accordance with admixture manufacturer's instructions.
 1. Admixture Products:
 - a. The QUIKRETE Companies; QUIKRETE® Concrete Bonding Adhesive: www.guikrete.com.
 - b. SpecChem, LLC; Acrylic Bonder: www.specchemllc.com.
 - c. W.R. Meadows, Inc.; Acry-lok: www.wrmeadows.com.
- C. Cementitious Resurfacing Mortar: One- or two-component, factory-mixed, polymer-modified cementitious mortar designed for continuous thin-coat application.
 - 1. Mixed with water or latex type bonding agent in proportions as recommended by manufacturer.
 - 2. Recommended Thickness: Feather edge to 1/8 inch.
 - 3. Color: Light gray.
 - 4. Products:
 - a. ARDEX Engineered Cements; ARDEX Feather Finish: www.ardexamericas.com.
 - b. ARDEX Engineered Cements; ARDEX MRP: www.ardexamericas.com.
 - c. ARDEX Engineered Cements; ARDEX SKM: www.ardexamericas.com.
 - d. SpecChem, LLC: Duo Patch: www.specchemllc.com.
- D. Cementitious Repair Mortar, Trowel Grade: One- or two-component, factory-mixed, polymer-modified cementitious mortar.
 - 1. Mixed with water or latex type bonding agent in proportions as recommended by manufacturer.
 - 2. Products:
 - a. ARDEX Engineered Cements; ARDEX Forti Finish: www.ardexamericas.com.
 - b. ARDEX Engineered Cements; ARDEX ERM: www.ardexamericas.com.
 - c. ARDEX Engineered Cements; ARDEX PC-R: www.ardexamericas.com.
 - d. The QUIKRETE Companies; QUIKRETE® FastSet Repair Mortar: www.quikrete.com.
 - e. SpecChem, LLC; RepCon V/O: www.specchemllc.com.
 - f. SpecChem, LLC; Duo Patch: www.specchemllc.com.
 - g. Meadow-Crete GPS: www.wrmeadows.com.
- E. Cementitious Repair Mortar, Form and Pour/Pump Grade: Flowable, one- or two-component, factory-mixed, polymer-modified cementitious mortar; in-place material resistant to freeze/thaw conditions.
 - 1. Mixed with water in proportions as recommended by manufacturer.
 - 2. Products:
 - a. ARDEX Engineered Cements; ARDEX FDM: www.ardexamericas.com.
 - b. ARDEX Engineered Cements; ARDEX FDX: www.ardexamericas.com.
 - c. SpecChem, LLC; Duo Patch; www.specchemllc.com.
 - d. W.R. Meadows, Inc.; Meadow-Crete FNP: www.wrmeadows.com.
- F. Pre-Blended Concrete Mix for Small Projects: Construction-grade Portland cement uniformly blended with aggregates and other approved concrete ingredients, requiring only the addition of water.
 - 1. Compressive Strength: 4000 pounds per square inch, minimum, at 28 days, when tested in accordance with ASTM C39/C39M.
 - 2. Products:
 - a. The QUIKRETE Companies; QUIKRETE® Concrete Mix: www.quikrete.com.

- b. The QUIKRETE Companies; QUIKRETE® Crack Resistant Concrete Mix: www.quikrete.com.
- 2.3 EPOXY PATCHING AND REPAIR MATERIALS:
 - A. Acceptable Manufacturers:
 - 1. SpecChem, LLC: www.specchemllc.com.
 - 2. W.R. Meadows, Inc.: www.wrmeadows.com.
 - B. Epoxy Repair Mortar: Epoxy resin mixed with aggregate and other materials in accordance with manufacturer's instructions for purpose intended; conform to pot life and workability limits.
 - 1. Products:
 - a. The QUIKRETE Companies; QUIKRETE® FastSet Anchoring Epoxy: www.quikrete.com.
 - b. SpecChem, LLC; SpecPoxy 1000, SpecPoxy 2000, SpecPoxy 3000 or SpecPoxy 3000 FS: www.specchemllc.com.
 - c. W.R. Meadows, Inc.; Rezi-Weld Gel Paste, Rezi-Weld Gel Paste State, Rezi-Weld 1000, Rezi-Weld LV, or Rezi-Weld LV State: www.wrmeadows.com.
 - C. Epoxy Injection Adhesive:
 - 1. Products:
 - a. Adhesives Technology Corporation; Crackbond LR-321: www.atcepoxy.com
 - b. SpecChem, LLC; SpecPoxy 1000; www.specchemllc.com.
 - c. W.R. Meadows, Inc.; Rezi-Weld LV, Rezi-Weld LV State, Rezi-Weld (IP), or Rezi-Weld Gel Paste: www.wrmeadows.com.
 - D. Epoxy Bonding Adhesive: Non-sag, two-part, 100 percent solids; recommended by manufacturer for purpose and conditions under which used.
 - 1. Non-Load-Bearing Applications: ASTM C881/C881M Type I, II, IV, or V, whichever is appropriate to application.
 - 2. Load-Bearing Applications: ASTM C881/C881M Type IV or V, whichever is appropriate to application.
 - 3. Other Applications: ASTM C881/C881M Type as appropriate to application.
 - 4. Products:
 - a. Adhesives Technology Corporation; Ultrabond 2100: www.atcepoxy.com.
 - b. SpecChem, LLC; SpecPoxy 2000: www.specchemllc.com.
 - c. SpecChem, LLC; SpecPoxy 3000: www.specchemllc.com.
 - d. SpecChem, LLC; SpecPoxy 3000 FS: www.specchemllc.com.
 - e. W.R. Meadows, Inc.; Rezi-Weld 1000: www.wrmeadows.com.

2.4 ACCESSORIES:

- A. Anchoring Adhesive: Self-leveling or non-sag as applicable.
 - 1. Self-Leveling Polyester-Based Products:
 - a. W.R. Meadows, Inc.; Poly-Grip: www.wrmeadows.com.
 - 2. Self-Leveling Epoxy Products:
 - a. SpecChem, LLC; SpecPoxy 2000; www.specchemllc.com.
 - b. W.R. Meadows, Inc.; Rezi-Weld 1000, Rezi-Weld (IP), or Rezi-Weld 3/2: www.wrmeadows.com.
 - 3. Non-Sag Epoxy Products:
 - a. SpecChem, LLC; SpecPoxy 3000 or SpecPoxy 3000 FS: www.specchemllc.com.
 - b. W.R. Meadows, Inc.; Rezi-Weld Gel Paste or Rezi-Weld Gel Paste State: www.wrmeadows.com.
- B. Portland Cement: ASTM C150/C150M, Type I, grey.

- C. Sand: ASTM C33/C33M or ASTM C404; uniformly graded, clean.
- D. Water: Clean and potable.
- E. Reinforcing Steel: ASTM A615/A615M Grade 40 (40,000 psi) billet-steel deformed bars, unfinished.
- F. Reinforcing Steel: Deformed bars, ASTM A996/A996M Grade 40 (280), Type A.
 1. Galvanized in accordance with ASTM A767/A767M, Class I.
- G. Stirrup Steel: ASTM A1064/A1064M.

PART 3 - EXECUTION

- 3.1 EXAMINATION:
 - A. Verify that surfaces are ready to receive work.
 - B. Beginning of installation means acceptance of substrate.

3.2 CLEANING EXISTING CONCRETE:

- A. Provide enclosures, barricades, and other temporary construction as required to protect adjacent work from damage.
- B. Clean concrete surfaces of dirt or other contamination using the gentlest method that is effective.
 - 1. Try the gentlest method first, then, if not clean enough, use a less gentle method taking care to watch for impending damage.
 - 2. Clean out cracks and voids using same methods.
- C. The following are acceptable cleaning methods, in order from gentlest to less gentle:
 - 1. Water washing using low-pressure, maximum of 100 psi, and, if necessary, brushes with natural or synthetic bristles.
 - 2. Increasing the water washing pressure to maximum of 400 psi.
 - 3. Adding detergent to washing water; with final water rinse to remove residual detergent.
 - 4. Steam-generated low-pressure hot-water washing.
- D. Do not use any of the following cleaning methods, unless otherwise indicated:
 - 1. Brushes with wire bristles, grinding with abrasives, solvents, hydrochloric or muriatic acid, sodium hydroxide, caustic soda, or lye.
 - 2. Soap or detergent that is not non-ionic.
 - 3. Alkaline cleaning agents.
 - 4. Acidic cleaning agents.
 - 5. Abrasive blasting.

3.3 CRACK REPAIR USING EPOXY ADHESIVE INJECTION:

- A. Repair exposed cracks.
- B. Provide temporary entry ports spaced to accomplish movement of fluids between ports; no deeper than the depth of the crack to be filled or port size diameter no greater than the thickness of the crack. Provide temporary seal at concrete surface to prevent leakage of adhesive.

- C. Inject adhesive into ports under pressure using equipment appropriate for particular application.
- D. Begin injection at lower entry port and continue until adhesive appears in adjacent entry port. Continue from port to port until entire crack is filled.
- E. Remove temporary seal and excess adhesive.
- F. Clean surfaces adjacent to repair and blend finish.
- 3.4 CONCRETE SURFACE REPAIR USING CEMENTITIOUS MATERIALS:
 - A. Clean concrete surfaces, cracks, and joints of dirt, laitance, corrosion, and other contamination using method(s) specified above and allow to dry.
 - B. Apply coating of bonding agent to entire concrete surface to be repaired.
 - C. Fill voids with cementitious mortar flush with surface.
 - D. Apply repair mortar by steel trowel to a minimum thickness of 1/4 inch over entire surface, terminating at a vertical change in plane on all sides.
 - E. Trowel finish to match adjacent concrete surfaces.
 - F. Damp cure for four days.

3.5 FIELD QUALITY CONTROL:

- A. An independent testing agency, as specified in Section 01400, will perform field inspection and testing.
 - 1. Test concrete for calcium chloride content during the execution of the Work.

END OF SECTION

SECTION 05400

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Interior structural stud framing at soffit ceiling where:
 - 1. Load is greater than 20 psf transverse.
 - 2. Load is greater than 200 lbs. axial.

1.2 RELATED REQUIREMENTS:

- A. Section 05500 Metal Fabrications, for masonry shelf angles and connections.
- B. Section 09260 Gypsum Board Shaft-Wall Assemblies for interior non-load-bearing, metal-studframed, shaft-wall assemblies.

1.3 REFERENCE STANDARDS:

- A. AISI S100-12 North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
- B. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- D. ASTM A1008/A1008M Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2013.
- E. ASTM A1011/A1011M Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.
- F. ASTM C955 Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases; 2011c.
- G. ASTM C1007 Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2011a.
- H. AWS D1.1/D1.1M Structural Welding Code Steel; American Welding Society; 2011 w/Errata.
- I. AWS D1.3/D1.3M Structural Welding Code Sheet Steel; American Welding Society; 2008.
- J. SSPC-Paint 20 Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).
- K. Steel Stud Manufacturers Association (SSMA).

L. Steel Framing Industry Association (SFIA).

1.4 PREINSTALLATION MEETINGS

- A. Refer also to Section 01310 Project Management and Coordination.
- B. Preinstallation Conference: Conduct conference at Project site.

1.5 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: For each type of cold-formed steel framing product and accessory.
 - 1. Product Test Reports: For each listed product, for tests performed a qualified testing agency.
 - a. Steel sheet.
 - b. Expansion anchors.
 - c. Power-actuated anchors.
 - d. Mechanical fasteners.
 - e. Vertical deflection clips.
 - f. Horizontal drift deflection clips
 - g. Miscellaneous structural clips and accessories.
- C. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- D. Delegated-Design Submittal: For cold-formed steel framing.
- E. Qualification Data:
 - 1. For testing agency.
 - 2. Welding certificates.
- F. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE:

- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code Sheet Steel."
- D. Comply with AISI S230 "Standard for Cold-Formed Steel Framing Prescriptive Method for One and Two Family Dwellings."
- 1.7 DELIVERY, STORAGE, AND HANDLING:

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS:
 - A. Manufacturers:
 - 1. <u>AllSteel & Gypsum Products, Inc</u>.
 - 2. California Expanded Metal Products Company.
 - 3. <u>ClarkWestern Building Systems, Inc</u>.
 - 4. <u>Consolidated Fabricators Corp.</u>; Building Products Division.
 - 5. Craco Mfg., Inc.
 - 6. <u>Custom Stud Inc</u>.
 - 7. <u>Design Shapes in Steel</u>.
 - 8. <u>Dietrich Metal Framing; a Worthington Industries Company</u>.
 - 9. Formetal Co. Inc. (The).
 - 10. <u>MarinoWARE</u>.
 - 11. Nuconsteel; a Nucor Company.
 - 12. <u>Olmar Supply, Inc</u>.
 - 13. Quail Run Building Materials, Inc.
 - 14. <u>SCAFCO Corporation</u>.
 - 15. <u>Southeastern Stud & Components, Inc.</u>
 - 16. <u>State Building Products, Inc</u>.
 - 17. <u>Steel Construction Systems</u>.
 - 18. <u>Steel Network, Inc. (The)</u>.
 - 19. <u>Steel Structural Systems</u>.
 - 20. <u>Steeler, Inc</u>.
 - 21. Super Stud Building Products, Inc.
 - 22. Telling Industries, LLC.
 - 23. United Metal Products, Inc.
 - 24. United Steel Manufacturing
- 2.2 PERFORMANCE REQUIREMENTS:
 - A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01400 Quality Requirements, design cold-formed steel framing.
 - B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As indicated.
 - 2. Deflection Limits: Design framing systems to withstand[design loads] without deflections greater than the following:
 - a. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 8.5 lbf/sq. ft.
 - b. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
 - 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
 - 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of **1/2 inch (13 mm)**.

COLD-FORMED METAL FRAMING

- 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Design Standards:
 - 1. Floor and Roof Systems: AISI S210.
 - 2. Wall Studs: AISI S211.
 - 3. Headers: AISI S212.
 - 4. Lateral Design: AISI S213.
- D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.
- E. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- 2.3 COLD-FORMED STEEL FRAMING, GENERAL:

1.

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: ST33H (ST230H).
 - 2. Coating: G60 (Z180) or equivalent.
- C. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: 33 (230), 50 (340), or as required by structural performance.
 - 2. Coating: G60 (Z180) or G90 (Z275).

2.4 LOAD-BEARING WALL FRAMING:

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As indicated.
 - 2. Flange Width: As indicated.
 - 3. Section Properties: As indicated.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As indicated.
 - 2. Flange Width: As indicated.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As indicated.
 - 2. Flange Width: As indicated.
 - 3. Section Properties: <Insert minimum allowable calculated section modulus, moment of inertia, and allowable moment>.
- D. Steel Single- or Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:
 - 1. Minimum Base-Metal Thickness: As indicated.

- 2. Top Flange Width: As indicated.
- 3. Section Properties: As indicated.
- 2.5 CEILING JOIST FRAMING:
 - A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As indicated.
 - 2. Flange Width: As indicated.
 - 3. Section Properties: As indicated.

2.6 FRAMING ACCESSORIES:

- A. Fabricate steel-framing accessories from steel sheet, ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. Anchor clips.
 - 5. End clips.
 - 6. Foundation clips.
 - 7. Gusset plates.
 - 8. Stud kickers and knee braces.
 - 9. Joist hangers and end closures.
 - 10. Hole reinforcing plates.
 - 11. Backer plates.

2.7 ANCHORS, CLIPS, AND FASTENERS:

- A. Steel Shapes and Clips: ASTM A36/A 6M, zinc coated by hot-dip process according to ASTM A123/A123M.
- B. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- E. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS:

A. Galvanizing Repair Paint: As indicated.

- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.
- D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.9 FABRICATION:

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
 - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION:

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

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- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL:

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 07210 "Building Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 LOAD-BEARING WALL INSTALLATION:

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
 - 1. Anchor Spacing: As indicated.
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch (3 mm) between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
 - 1. Stud Spacing: As indicated.
 - 2. Stud Spacing: As indicated.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
 - 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
 - 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
 - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced vertically as indicated. Fasten at each stud intersection.
 - 1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches (150 mm) deep.
 - 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated

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and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

- 3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION: NA

3.6 JOIST INSTALLATION:

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 - 1. Install joists over supporting frame with a minimum end bearing of 3 inches.
 - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:
 1. Joist Spacing: As indicated.
- D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated.
 - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated. Fasten bridging at each joist intersection as follows:
 - 1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
 - 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 FIELD QUALITY CONTROL:

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 REPAIRS AND PROTECTION:

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Shop fabricated steel, aluminum, and miscellaneous metal items.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Loose steel lintels.
 - 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
 - 3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
- C. Miscellaneous framing and supports including, but not limited to the following:
 - 1. Carpenter's ironwork.
 - 2. Bent bar or angle frame countertop supports and backing plates.
 - 3. Applications where framing and supports are not specified in other sections.
 - 4. Frames for glass and decorative plastic glazing.
 - 5. Hangers & Supports per Mechanical, Plumbing & Electrical Drawings.
- 1.2 RELATED REQUIREMENTS:
 - A. Section 09900 Painting and Coatings: Paint finish.
- 1.3 COORDINATION:
 - A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
 - B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 SUBMITTALS:

- A. Submit under provisions of Section 01300.
- B. Product Data: For the following:
 - 1. Paint products.
 - 2. Grout.
- D. Shop Drawings: Show fabrication and installation details.[Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Loose steel lintels.
- E. Samples for Verification: For each type and finish of extruded nosing and tread.

- F. Qualification Data: For professional engineer.
- G. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
- Η. Welding certificates.
- Ι. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- J. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Design shall be under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Nevada.
- Β. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- Welding Qualifications: Qualify procedures and personnel according to the following: C.
 - AWS D1.1/D1.1M, "Structural Welding Code Steel." 1.
 - 2.
 - AWS D1.2/D1.2M, "Structural Welding Code Aluminum." AWS D1.6/D1.6M, "Structural Welding Code Stainless Steel." 3.
- 1.6 **FIELD CONDITIONS**
 - A. Field Measurements: Take field measurements prior to preparation of Shop Drawings and fabrication, where possible, to ensure proper fitting of the Work. Allow for trimming and fitting wherever the taking of field measurements before fabrication might delay the Work.

PART 2 - PRODUCTS

- 2.1 PERFORMANCE REQUIREMENTS:
 - Α. Delegated Design: Engage a qualified professional engineer, as defined in Section 01400 -Quality Requirements, to design ladders and alternating tread devices.
 - Β. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material 1. surfaces.

2.2 METALS:

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- Β. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- C. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

- D. Stainless-Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304, Type 316L.
- E. Stainless-Steel Bars and Shapes: ASTM A76, Type 304, Type 316L.
- F. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A283/A283M, Grade C or D.
- G. Rolled-Stainless-Steel Floor Plate: ASTM A793.
- H. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallically bonded to steel.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. IKG Industries, a division of Harsco Corporation; Mebac.
 - 3. SlipNOT Metal Safety Flooring, a W. S. Molnar company; SlipNOT.
- I. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- J. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- K. Zinc-Coated Steel Wire Rope: ASTM A741.
 - 1. Wire-Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.
- L. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 1. Size of Channels: As indicated.
 - 2. Design Requirements: Design structural members in accordance with the following:
 - a. Design system in accordance with the following Standards:
 - 1) Federal, State and Local Codes.
 - 2) American Iron and Steel Institute (AISI) Specifications for the Design of Cold- Formed Steel Structural Members, 2001 Edition.
 - 3) American Society for Testing and Materials (ASTM).
 - 4) Metal Framing Manufacturer's Association (MFMA).
 - 3. Material: Galvanized steel, ASTM A653/A653M, commercial steel, Type B structural steel, Grade 33 (Grade 230), with G90 (Z275) coating; 0.108-inch (2.8-mm), 0.079-inch (2-mm), 0.064-inch (1.6-mm) nominal thickness.
 - 4. Material: Cold-rolled steel, ASTM A1008/A1008M, commercial steel, Type B structural steel, Grade 33 (Grade 230); 0.0966-inch (2.5-mm), 0.0677-inch (1.7-mm), 0.0528-inch (1.35-mm) minimum thickness; coated with hot-dip galvanized after fabrication.
 - 5. Design system to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature changes.
 - 6. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
 - a. Construction Tolerances: Plus or minus 1/2 inch minimum (all directions).
 - b. Live load deflection of building structural elements: 1 inch minimum (to be confirmed by Engineer of Record).
 - 7. Engineering Responsibility: Slotted channel framing manufacturer shall assume undivided responsibility for engineering slotted channel framing system by employing a qualified professional engineer to prepare and seal design calculations, shop drawings, and other structural data. Engineer to be licensed in the State of State.
- M. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

- N. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- O. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- P. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- Q. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- R. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).
- S. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).
- T. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500.
- U. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.3 FASTENERS

- 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 (ASTM F1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
 - 3. Provide stainless-steel fasteners for fastening nickel silver.
 - 4. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3 (ASTM A325M, Type 3); with hex nuts, ASTM A563, Grade C3 (ASTM A563M, Class 8S3); and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F593 (ASTM F738M); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 1 (A1), Group 2 (A4).
- E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

- 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
- Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1), Group 2 (A4) stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).
- I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Shop Primers: Provide primers that comply with Section 09900 Painting and Coatings.
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
 - 1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
- E. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
 - Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. <Insert, in separate subparagraphs, manufacturer's name; product name or designation>.
- F. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- G. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- H. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- I. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- 2.5 FABRICATION, GENERAL:

1

- 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 (1 mm) 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.
 - At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS:

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes as indicated, recommended by partition manufacturer with attached bearing plates, anchors, and braces as indicated, recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
 - 1. Provide bearing plates welded to beams where indicated.
 - 2. Drill or punch girders and plates for field-bolted connections where indicated.
 - 3. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches (600 mm) o.c.
- E. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.
 - 1. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
 - 2. Unless otherwise indicated, provide 1/2-inch (12.7-mm) baseplates with four 5/8-inch (16-mm) anchor bolts and 1/4-inch (6.4-mm) top plates.
- F. Galvanize miscellaneous framing and supports where indicated.
- G. Prime miscellaneous framing and supports with [zinc-rich primer] [primer specified in Section 09960 "High-Performance Coatings"] where indicated.

2.7 MISCELLANEOUS STEEL TRIM:

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

2.8 LOOSE STEEL LINTELS:

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 14 inches (200 mm) unless otherwise indicated.
- C. Galvanize and prime loose steel lintels located in exterior walls.
- D. Prime loose steel lintels located in exterior walls with zinc-rich primer. Primer specified in Section 09900 Painting and Coatings.
- 2.9 FINISHES, GENERAL:
 - A. Finish metal fabrications after assembly.
 - B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.
- 2.10 STEEL AND IRON FINISHES:

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- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A 53M 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.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 1. Shop prime with universal shop unless zinc-rich primer is indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 1. Prepare surfaces to be primed in accordance with SSPC-SP2.
- F. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.11 ALUMINUM FINISHES:

- A. Interior Aluminum Surfaces: Class I natural anodized.
- B. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.
- C. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils thick; light bronze.
- D. High Performance Organic Coating System: AAMA 2604 multiple coat, thermally cured fluoropolymer system; color as scheduled.
- E. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.12 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 - EXECUTION

- 3.1 INSTALLATION, GENERAL:
 - A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

METAL FABRICATIONS

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

3.2 INSTALLATION - SLOTTED CHANNEL FRAMING SYSTEMS

- A. For ceiling channel, rails shall be on centers as required by equipment manufacturer and allow continuous attachment along any point on the rail. System shall be true, plumb, and level to the tolerances specified.
- B. Framing shall be adjusted as required in the field to avoid interferences.
- C. Hammer drilling times shall be coordinated in existing facilities with the Owner.
- D. All bolted connections into cold-formed channel members with channel nuts shall be tightened to a minimum:
 - 1. 50 ft-lbs for $\frac{1}{2}$ " bolts.
 - a. 100 ft-lbs for 5/8" bolts.
 - 2. 125 ft-lbs for $\frac{3}{4}$ " bolts.
- E. All bolted connections for structural steel joints shall be per ASIC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.

3.3 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS:

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for ceiling hung toilet partitions, operable partitions, overhead doors and overhead grilles securely to, and rigidly brace from, building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of

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pipe columns.

- 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
 - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.
- 3.4 FIELD QUALITY CONTROL FOR SLOTTED CHANNEL FRAMING SYSTEMS
 - A. General: Conventional Testing and Inspection Services specified herein describe those items not specifically required by IBC, but may be considered essential to the proper performance of the slotted channel framing systems.
- 3.5 ADJUSTING AND CLEANING
 - A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
 - B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09900 Painting and Coatings.
 - C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.
 - D. Transport debris and excess materials from site and legally dispose of them.

END OF SECTION

SECTION 06410

CUSTOM CASEWORK

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Plastic laminate clad custom casework.
 - B. Cabinet hardware.

1.2 RELATED REQUIREMENTS:

- A. Section 09260 Gypsum Board Systems.
- B. Section 09900 Painting.

1.3 REFERENCES:

- A. ANSI A135.4 American National Standard for Basic Hardboard; 2012.
- B. ANSI A208.1 American National Standard for Particleboard; 2009.
- C. ANSI A208.2 American National Standard for Medium Density Fiberboard for Interior Use; 2009.
- D. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- E. AWI (QCP) Quality Certification Program, www.awiqcp.org; current edition at www.awiqcp.org.
- F. AWI/AWMAC/WI (AWS) Architectural Woodwork Standards; 2014.
- G. BHMA A156.9 American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.9).
- H. HPVA HP-1 American National Standard for Hardwood and Decorative Plywood; Hardwood Plywood & Veneer Association; 2009 (ANSI/HPVA HP-1).
- I. NEMA LD 3 High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.
- J. WI (CCP) Certified Compliance Program (CCP); current edition at www.woodworkinstitute.com/certification.
- K. National Electric Manufacturers Association (NEMA) LD3 High Pressure Decorative Laminates.
- L. PS 1 Construction and Industrial Plywood.
- M. PS 20 American Softwood Lumber Standard.

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data:
 - 1. Provide data for hardware accessories.
 - 2. Adhesive manufacturer's product data for each adhesive used indicating that the adhesive contains no urea formaldehyde.
- C. Provide UL approved identification on fire retardant treated material.
- D. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location, and schedule of finishes.
- E. Samples: Submit two (2) samples, illustrating plastic laminate material finish.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum 10 years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Single-Source Responsibility for Fabrication and Installation: Engage qualified woodworking firm to assume undivided responsibility for fabricating, finishing, and installing woodwork specified in this Section.
- C. Perform all work of this section in accordance with AWI Custom quality standards.
- D. Regulatory Requirements:
 - 1. Flame Spread Index: Where fire-retardant treated wood is specified or required by IBC Chapter 8 requirements, provide materials that have been tested in accordance with ASTM E84 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 2. Fire-retardant treated materials shall be identified with appropriate classification markings indicating rating on surfaces that will be concealed from view in the finished work or by separate removable label applied by the treated wood Manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle products to site under provisions of Section 01600.
- B. Protect units from moisture damage.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. During and after installation of work of this section, maintain the same temperature and humidity conditions in building spaces as will occur after occupancy.
- 1.8 FIELD MEASUREMENTS
 - A. Verify that field measurements are as indicated on shop drawings.

1.9 COORDINATION

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A. Coordinate the work with plumbing and electrical rough-in and adjacent finishes.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI//AWMAC/WI (AWS) for Premium Grade.

2.2 WOOD MATERIALS:

- A. Lumber: PS 20; graded in accordance with established Grading rules; maximum moisture content of 4 to 9 percent; of following species and grades:
 - 1. Structural Light Framing: Select structural; No. 1 grade.
 - 2. Non-structural Light Framing: Standard grade.
- B. Framing Plywood: PS 1; factory grade.
- C. Softwood Plywood: Graded in accordance with AWI, Custom Grade.
- D. Wood Particleboard: AWI standard, composed of wood chips, medium density of grade to suit application; sanded faces.
- E. Masonite: ANSI A135.4, pressed wood fiber with resin binder, tempered grade, smooth both sides. Provide in thicknesses shown on drawings.

2.3 WOOD TREATMENT PROCESS

- A. Fire-Retardant Treatment:
 - 1. All architectural woodwork used in the interior of the building shall be fire retardant treated, except where allowed otherwise by Code.
 - 2. Fire Retardant: Chemically treated and pressure impregnated; capable of providing flame spread/smoke developed ratings as follows and in accordance with ASTM E84 and as defined by IBC Chapter 8 requirements.
 - a. Interior Wall and Ceiling Finishes:
 - 1) Vertical Exits, Exit Access Corridors, Exit Passageways and Other Exit ways: Class "B" (26-75) flame spread index, 0-450 smoke developed.
 - 2) Rooms and Enclosed Spaces: Class "C" (76-200) flame spread index, 0-450 smoke developed.
 - b. Trim (moldings, chair rails, baseboards, handrails, wood door and window frames, and similar decorative items):
 - 1) All Areas: Class "C" 76-200 flame spread, 0-450 smoke developed.
 - 3. Where wood is indicated to be clear finished or stained, do not used fire-retardant treatment with colorants, that would bleed through the finish, or that would otherwise adversely affect finish.

2.4 PLASTIC LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Formica Corporation: www.formica.com.
 - 2. Nevamar: www.nevamar.com
 - 3. Wilsonart, LLC. www.wilsonart.com.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

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- C. Provide specific types as scheduled.
 - 1. Finishes, colors, patterns and textures as indicated on the Drawings or selected by the Architect.
 - 2. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.
- D. Plastic Laminate: NEMA Standards, high pressure plastic laminate, 0.050 inch at horizontal surfaces, 0.030 inch at vertical surfaces, General Purpose quality, color and finish as shown on drawings.
- E. Laminate Backing Sheet: 0.020 inch Backing Sheet grade, undecorated plastic laminate.

2.5 SOLID SURFACE MATERIALS:

- A. Quartz based solid surface material.
- B. Approved manufacturers
 - 1. Silestone.
 - 2. Zodiac.
 - 3. Corian.
 - 4. Cambria.
 - 5. Dupont.
- C. Thickness: 3/4 inch thick in width required to provide a seamless installation from front to back.
- D. Color and Pattern: As shown on drawings.

2.6 HARDWARE

- A. Hardware: BHMA A156.9, types as indicated for quality grade specified.
- B. Shelf Standards: Knape & Vogt, 255 NP series steel, recessed pilaster standards with 1/2" adjustments.
- C. Adjustable Shelf Supports: Standard back-mounted system using surface mounted metal shelf standards and coordinated cantilevered shelf brackets, satin chrome finish, for nominal 1 inch spacing adjustments.
- D. Cabinet Locks:
 - 1. Keyed cylinder, two keys per lock, steel with chrome finish.
 - 2. Best 5L Series Dead Bolt, Rim Mounted Cabinet Locks, individual keyed per room and master keyed.
- E. Catches: Magnetic catch at each door, heavy duty with 100 lb. pull.
- F. Drawer Slides:
 - 1. Type: Extension types as required.
 - 2. Conforming to ANSI/BIFMA X5.6, UL 1678 and UL 1286.
 - a. Light and medium duty drawers -24 inch wide or less: Accuride 7432 ball bearing, rail mount, full extension slides with 100 lb. /pr. load rating. Provide Accuride 7434 overtravel slides where drawers require full access.
 - b. Heavy duty drawers 42 in wide or less: Accuride 3640A ball bearing, rail mount, full extension slides plus 1 inch (25mm) overtravel with 200 lb. /pr. load rating.
 - c. Finish: Clear zinc.
 - 3. Static Load Capacity: Commercial grade.

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- 4. Mounting: Side mounted.
- 5. Stops: Integral type.
- 6. Features: Provide self-closing/stay closed type.
- 7. Products:
 - a. Accuride International, Inc.: <u>www.accuride.com</u>.
 - b. Knape & Vogt Manufacturing Company: <u>www.knapeandvogt.com</u>.
 - c. Grass America Inc.: <u>www.grassusa.com</u>.
- G. Hinges: Blum sprung 125 deg. clip type or approved equal.
- H. Door and Drawer Pulls: Clear anodized aluminum wire pulls, Euroconcepts "300A Series".
- I. Grommets: Minimum of six (6) 3 inch diameter plastic or vinyl cable grommets with covers in reception counter. Locations to be determined by Owner.

2.7 ACCESSORIES:

- A. Edge Trim for Wood Veneer Faced Casework: Matching solid hardwood edge of same species as face veneer. Thickness and profile as indicated on Drawings or as selected, 1/8 inch minimum.
- B. Adhesive: Type recommended by AWI or laminate manufacturer to suit application.
- C. Fasteners: Size and type to suit application.
- D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application.
- E. Concealed Joint Fasteners: Threaded steel.
- F. Sealant: As specified in Section 07900 Joint Sealers.

2.8 FABRICATION:

- A. All work shown to be plastic laminate clad shall be in accordance with the tolerances and requirements of AWI, Section 400B, Laminate Clad Cabinets; Custom Grade.
- B. Fabricate to design and details as shown on the drawings.
- C. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- D. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- E. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- F. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.
- G. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
- H. Mechanically fasten back splash to countertops with steel brackets.
- I. Provide cutouts for plumbing fixtures, inserts, outlet boxes fixtures and fittings and control boxes. Verify locations of cutouts from on-site dimensions. Seal contact surfaces of cut

edges. Provide vinyl grommets, sized for opening, at all exposed cutouts.

J. Sand hardwood trim and ease exposed edges. Finish with transparent stain, selected by Architect, and as specified in Section 09900 - Painting.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify adequacy of backing and support framing.

3.2 INSTALLATION:

- A. Set and secure casework in place; rigid, plumb, and level.
- B. Use fixture attachments in concealed locations for wall mounted components.
- C. Use concealed joint fasteners to align and secure adjoining casework units and counter tops.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- E. Secure casework and counter bases to floor using appropriate angles and anchorages.
- F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.
- G. Coordinate with Division 16 for lighting fixtures, conduit, boxes and controls.

3.3 ADJUSTING:

- A. Adjust moving or operating parts to function smoothly and correctly.
- B. Adjust all drawers and doors for even clearances and horizontal alignment.

3.4 CLEANING:

A. Clean casework, counters, shelves, hardware, fittings and fixtures. END OF SECTION

SECTION 07015

PREPARATION FOR RE-ROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Partial removal and repair of existing roofing system.
- B. The work shall include the furnishing of all labor, tools, materials, equipment, transportation, and the performance of all operations required to provide construction as specified herein and shall include the cleanup and removal from site, all debris resulting from the operations performed. It shall also be the Contractor's responsibility to take all necessary safety precautions and to furnish barricades and/or safety measures as required.
- C. The Contractor shall make all necessary notices for warranty purposes to the primary roofing manufacturer, to secure timely inspections and issuance of the warranty.
- D. Location of Work:1. As documented in Drawings.

1.2 RELATED REQUIREMENTS:

- A. Section 01732 Selective Demolition:
- B. Section 07620 Sheet Metal Flashing and Trim:
- 1.3 REFERENCE STANDARDS:
 - A. ASTM C1177/C1177M Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
 - B. ASTM D1079-13e1 Standard Terminology Relating to Roofing and Waterproofing; 2013e1
 - C. Building Code: 2012 International Building Code (IBC) and local amendments.

1.4 DESCRIPTION:

- A. This section is for the convenience of the Contractor only and shall not be construed as a complete accounting of all work to be performed.
- B. The documents are performance based and provide for the minimum acceptable performance, design intent, engineering, performance, construction, and installation standards. The project documents provide for the basic intent regarding the roof repairs, and related work. The documents do not address all roofing and roofing related items required for the completion of the work and shall not be construed to limit the scope of the roofing installer's responsibility for the work.
- C. The Contractor shall examine the site and shall be responsible for verifying all existing construction and conditions.
- D. The contractor shall repair existing roofing systems, replace existing roofing systems, install

new roofing and related roofing work and all other work at or adjacent to roof surfaces to provide for a completely watertight condition of roof areas (including but not limited to MEP systems) and adjacent systems that require work to provide for a watertight exterior (including but not limited to exterior sealants.) MEP equipment and systems shall be disconnected, raised, removed and replaced to allow for the proper and completely watertight installation of the new roofing systems. Conduit / piping that is currently placed within the existing roofing and / or impedes the drainage of water shall be removed, raised, altered as required and replaced to allow for the new roofing systems and to allow for positive drainage.

1.5 DEFINITIONS:

- A. Roofing Terminology: Refer to ASTM D1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.
- B. Existing Membrane Roofing System: 60 mil, mechanically attached PVC membrane, roof insulation, surfacing, and components and accessories between deck and roofing membrane.
- C. Roof Re-Cover Preparation: Existing roofing membrane that is to remain and be prepared for reuse.
- D. Roof Tear-Off: Removal of existing membrane roofing systems and built up roof system structure.
- E. Partial Roof Tear-Off: Removal of a portion of existing membrane roofing system from deck or removal of selected components and accessories from existing membrane roofing system.
- F. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and reinstalled.
- G. Existing to Remain: Existing items of construction that are not indicated to be removed.

1.6 SUBMITTALS

- A. See Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: For each type of product indicated.
- C. Temporary Roofing: Include Product Data and description of temporary roofing system. If temporary roof will remain in place, submit surface preparation requirements needed to receive permanent roof, and submit a letter from roofing membrane manufacturer stating acceptance of the temporary membrane and that its inclusion will not adversely affect the roofing system's resistance to fire and wind uplift.
- D. Fastener pull-out test report.

1.7 QUALITY ASSURANCE:

- A. Contractor shall have a minimum of ten (10) years experience in successfully applying the same or similar materials and shall be approved by the primary materials manufacturer.
- B. Contractor must have a valid Roofing Contractors License under the same company name for a period of no less than 10 years.
- C. Installer Qualifications: Installer of new membrane roofing system, licensed to perform asbestos abatement in the State or jurisdiction where Project is located and approved by warrantor of

existing roofing system to work on existing roofing.

- D. The Contractor shall notify the Owner and Architect in a timely manner of the proposed start date of the roof application.
- E. Upon commencement of the roofing work, the Contractor shall diligently and continuously pursue the project until completion.
- F. The Contractor shall employ sufficient installers and have proper equipment and materials on site so as to complete the work in a timely manner.
- G. All roll goods must be manufactured by the primary roofing manufacturer. No private labeled products will be allowed.
- H. Whenever specification items found herein are less stringent than Manufacturers' requirements, Manufacturers' requirements shall be followed.
- I. Regulatory Requirements: Comply with governing EPA notification regulations before beginning membrane roofing removal. Comply with hauling and disposal regulations of authorities having jurisdiction.
- J. Roof systems manufacturer's technical representative shall provide quality assurance in conjunction with the roofing installation. During each visit, the manufacturer's technical representative shall check all work installed since the last visit, mark all defects for repair, and provide a written site visitation report listing any deficient work requiring correction by the Contractor. All reports and other correspondence associated with the site visit shall be provided to the Construction Manager within three (3) business days of the visit.
- K. The manufacturer's technical representative shall coordinate all site visits with the Contractor and Owner's Representative a minimum of three (3) business days in-advance.

1.8 ADMINISTRATIVE REQUIREMENTS:

- A. Coordinate with affected mechanical and electrical work associated with roof penetrations.
- B. Preinstallation Meeting: Convene one week before starting work of this section.
 - 1. Review methods and procedures related to roofing system tear-off and replacement including, but not limited to, the following:
 - a. Reroofing preparation, including membrane roofing system manufacturer's written instructions.
 - b. Temporary protection requirements for existing roofing system that is to remain during and after installation.
 - c. Existing roof drains and roof drainage during each stage of reroofing, and roof drain plugging and plug removal requirements.
 - d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - e. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that will affect reroofing.
 - f. HVAC shutdown and sealing of air intakes.
 - g. Shutdown of fire-suppression, -protection, and -alarm and -detection systems.
 - h. Asbestos removal and discovery of asbestos-containing materials.
 - i. Governing regulations and requirements for insurance and certificates if applicable.
 - j. Existing conditions that may require notification of Architect before proceeding.

1.9 PROTECTION:

- A. Protect building contents and grounds during the process of the work.
 - 1. Protect all paving, walls of building and building adjacent to hoist prior to starting work.
 - 2. Windows, doorways, docks, walkways, etc., may require special protection measures.
- B. Remove all debris daily from the roof and haul off site.
- C. Contractor shall be responsible for meeting fire regulations. A certified fire extinguisher of adequate size shall be located on the roof and elsewhere as required.
- D. All roofing work shall commence at the furthest point from worker access and progress back towards the access point.
- E. Contractor shall be responsible to exercise caution and/or protect finish roofing surfaces during roof-top activities, and to properly repair any damage that may result from such activities.
- F. In the event of damage, immediately repair or replace all damaged and/or defective work to the approval of the Architect, and at no additional cost to the District.

1.10 PROJECT CONDITIONS:

- A. Do not remove existing roofing membrane when weather conditions threaten the integrity of the building contents or intended continued occupancy.
- B. Maintain continuous temporary protection prior to and during installation of new roofing system.
- C. Hazardous Materials: It is not expected that Contractor will encounter hazardous materials such as asbestos-containing materials.
 - 1. Owner will remove hazardous materials before start of the Work.
 - 2. Do not disturb materials suspected of containing hazardous materials. Notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- D. 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.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Infill Materials:
 - 1. Use infill materials matching existing membrane roofing system materials unless otherwise indicated.
- B. Temporary Roofing Materials:
 - 1. Design and selection of materials for temporary roofing are responsibilities of the Roofing Contractor.
 - 2. Temporary Protection: Sheet polyethylene; provide weights to retain sheeting in position.
 - 3. Protection Board: ASTM C208 cellulose fiber board, one face finished with mineral fiber, asphalt and Kraft paper.
 - 4. Recover Board: Glass mat faced gypsum panels, ASTM C1177, moisture- and fire-resistant board with factory applied acrylic primer coating.

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C. Fasteners: Factory-coated steel fasteners, No. 12 or 14, and metal or plastic plates listed in FMG's "Approval Guide," designed for fastening recover boards to deck.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify that existing roof surface is clear and ready for work of this section.

3.2 GENERAL APPLICATION REQUIREMENTS

- A. Operations shall not be conducted when water in any significant form is present on deck, such as rain, dew, ice, frost, or snow.
- B. Precautions shall be taken to keep materials clean, dry and free of damage.
- C. At the end of each day, edge-seal the finished portion of the roofing system completed that day according to manufacturer's recommendations. Remove edge seals prior to the start of the next day's work.
- D. Start roofing work in dry weather only and without threat of immediate inclement weather.
- E. Keep the roofed area of the building watertight each day as the work progresses.
- F. All membrane seams, roof terminations and openings shall be made waterproof at the end of each day's work
- G. Use only materials and procedures that are proper and suitable for the slopes and for the underlying materials to which they are attached.
- H. Approved and operable fire extinguishers shall be on hand at all times on the roof. All additional requirements of OSHA Safety Regulations will be followed.

3.3 PREPARATION:

- A. Sweep roof surface clean of loose matter.
- B. Remove loose refuse and dispose off-site.
- C. Protect existing membrane roofing system that is indicated not to be reroofed.
 - 1. Verify and match existing roofing construction.
 - 2. Limit traffic and material storage to areas of existing roofing membrane that have been protected.
 - 3. Maintain temporary protection and leave in place until replacement roofing has been completed. Remove temporary protection on completion of reroofing.
- D. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work. 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.

Prevent debris from entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.

- 1. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new membrane roofing system, provide alternative drainage method to remove water and eliminate ponding. Do not permit water to enter into or under existing membrane roofing system components that are to remain.
- G. Verify that rooftop utilities and service piping have been shut off before beginning the Work.

3.4 DEMOLITION AND ROOF PREPARATION:

- A. The nature of the specifications is to provide for the intent of the work and performance criteria. The project documents provide for the basic intent regarding the roof repairs and new roofing systems. The documents do not address all roofing and roofing related items required for the completion of the work and shall not be construed to limit the scope of the roofing installer's responsibility for the work.
- B. Coordinate all aspects of demolition work with the Construction Manager.
- C. Coordinate work with the results of any Evaluation for Suspect Asbestos-Containing Roofing Materials (ACRM)
- D. Provide protective measures in and around the building to protect the building and adjacent surfaces from being soiled or damaged and as directed by the Construction Manager.
- E. As a general guideline, the overall project intent regarding the new roofing systems and / or repairs to existing and associated work is noted below. The items noted are a minimum requirement and the bidder shall fully examine the site and provide for all requirements of the manufacturer for installation in regards to that manufacturer's requirements to obtain the specified warranty and in concert with good practices and industry standards.
- F. Remove and replace existing copings, edge metals, counterflashings and other roofing related sheet metal flashings.
- G. Remove existing deteriorated decking as determined during post tear-off deck inspection and replace with like materials and to provide for a proper structural substrate.
- H. Remove deteriorated existing wood blocking and fascia and replace with new metal stud blocking.
- I. Remove debris from roof area and properly dispose of all materials off site.
- J. Watertest all roof drains (to determine if they are functioning properly or are clogged) before roof replacement work begins. Provide written results of said testing to Construction Manager. After new roof system installation is complete and before roof watertesting, watertest all drains again to determine if they are working properly. Provide written results of said testing to Construction Manager.
- K. Repair existing roof drains as required. Raise or lower roof drains as required to accommodate new roofing system. Properly clean all roof drains prior to installation of new roofing system.
- L. Clean existing drains down to the cast iron surface and prepare drains for membrane roofing. Remove broken drain bolts from drain castings, where required. Replace damaged roof drains that are beyond repair.

M. At the end of each day, ensure all drains are in proper working order, and drain lines are totally unrestricted. Implement and complete any required corrective measures before leaving the job site that day.

3.5 INFILL MATERIALS INSTALLATION:

- A. Immediately after removal of selected portions of existing membrane roofing system, and inspection and repair, if needed, of deck, fill in the tear-off areas to match existing membrane roofing system construction.
- B. Install new roofing membrane patch over roof infill area. If new roofing membrane is installed the same day tear-off is made, roofing membrane patch is not required.

3.6 LOW SLOPE ROOFING SYSTEM/FLASHINGS

- A. Install roofing in concert with performance specifications, as required by the manufacturer to obtain the specified warranty and in concert with NRCA recommendations, SPFA recommendations and industry accepted good practices.
- B. Install walkways as required by roof manufacturer, at roof access points and at serviceable rooftop units.

3.7 ROOF RELATED SHEET METAL

- A. Install roof related sheet metal components.
 - 1. A PVC-coated, heat-weldable sheet metal capable of being formed into a variety of shapes and profiles. 24 gauge, G90 galvanized metal sheet with a 20 mil unsupported roof membrane laminated on one side.
- B. Provide all necessary sealant primers, sealant, sealant tapes, solder/weld joints, and fasteners to ensure a watertight installation.

3.8 PLUMBING WORK

- A. Free any clogged drains or drain lines.
- B. Install new drain assemblies. If new drain assemblies are not installed then, at a minimum, prepare drains as noted herein.
- C. Replace all missing, damaged, plastic or improperly fit drain strainers, and/or clamping rings. All replacement drain strainers shall be cast iron strainers and shall fit with clamping rings. All replacement clamping rings shall be cast iron and shall properly fit with existing drain bolts.
- D. Install replacement drain bolts. Clean existing bolt sockets by retapping, where required.
- E. Clean, prime and paint drain rings and drain strainers, as follows:
 - 1. Surface preparation: Remove all old sealants, debris and loose rust and loose paint using power-assisted hand tools and/or solvents.
 - 2. Primer: Apply one coat of Rust-O-Leum's 1060/1069 Heavy Duty Primer.
 - 3. Finish: Apply one coat of Rust-O-Leum's 3400 Industrial Enamel
- F. Functional clamping ring shall be installed at each drain during the same workday as membrane installation.
- G. Raise, move and / or relocate any plumbing pipe penetrations that do not allow for the proper

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and recommended installation of the new roofing system.

3.9 MECHANICAL/ELECTRICAL WORK

- A. Disconnect and reconnect units as required for lifting.
- B. Extend ducts as required for raising curbs to provide for the minimum recommended base flashing and to facilitate the proper installation of the new roofing system.
- C. Raise, move and / or relocate any penetrations, piping, conduit or similar that are buried within the existing roofing and / or impede positive drainage in any way.
- D. Raise, move and / or relocate any penetrations that do not allow for the proper and recommended installation of the new roofing system.
- E. Repair, remove and / or reinstall any exterior, roof level ductwork to provide for a watertight condition.
- F. Remove Unistrut where it penetrates the roof and replace with supports that can be properly flashed to the existing or new roofing.

3.10 ROOFTOP UTILITIES

- A. The project will require the removal, relocation, raising, and modification or cleaning of existing rooftop utilities such as conduits, pipes and cables.
- B. In concert with roofing system, install new prefabricated supports to replace existing. Provide for a slip sheet under each block that is UV stable and compatible with the roofing system. At conduit / pipes where wood blocking will not provide for proper support / securement, provide for a premanufactured pipe / conduit support such as from Portable Pipe Hangars or equal. Provide for slip sheep as noted herein.
- C. Unless approved in advance by the Owner, all utilities shall remain in service during the course of the project. No service shall be disrupted without prior approval of the Owner.
- D. Prior to the start of any roof work, the Contractor shall ascertain the operational status of the rooftop utilities. After approval by the Owner all abandoned utilities shall be properly disconnected, terminated or capped and removed. Proper disposal of all abandoned utility materials shall be the responsibility of the Contractor.
- E. All modification to rooftop utilities shall meet applicable codes and Owner requirements.
- F. Cleaning or removal of the existing roofing shall be accomplished in such a manner so as to not damage the utility.
 - 1. Removal of existing roofing shall be accomplished to the extent required to perform the flashing work indicated and/or as required to have clear space beneath the utility to install the specified roof system.
 - 2. All damaged or removed pipe insulation shall be replaced.
- G. Relocation or raising of rooftop utilities shall be accomplished in such a manner as to meet the following requirements unless otherwise approved by the Owner and roofing system manufacturer and in concert with the proper installation of new roofing.
 - 1. Mechanical system items shall be raised to provide clearance from top of finished roof surface as required by the roofing system Manufacturer in order to supply the specified roofing system warranty and to allow for positive drainage.

3.11 ROOFTOP MECHANICAL EQUIPMENT:

- A. During the course of this project, some of the rooftop equipment will require lifting or modifications.
- B. The disconnection and connection of all ductwork and piping shall be accomplished by a properly licenses subcontractor.
- C. Prior to the start of any work, the operational status of the equipment shall be verified by the subcontractor. Any discrepancies shall be reported in writing to the Owner's representative.
- D. All modifications shall meet applicable codes and Owner standards.
- E. All rooftop mechanical equipment shall be verified and certified to be in proper working condition upon completion of the work.

3.12 FIELD QUALITY CONTROL:

- A. Independent agency inspection and testing will be provided under provisions of Section 01400.
- B. The drawings identify the exact limits to material removal.
- C. Testing will identify the condition of existing materials and their reuse, repair or removal.
- D. Perform fastener pull-out tests according to SPRI FX-1, and submit test report to Architect and roofing membrane manufacturer before installing new membrane roofing system.
 - 1. Obtain roofing membrane manufacturer's approval to proceed with specified fastening pattern. Roofing membrane manufacturer may furnish revised fastening pattern commensurate with pull-out test results.
 - 2. Test Reports: Indicate existing insulation moisture content.
 - 3. Perform adhesion test.

3.13 DISPOSAL:

- A. Collect demolished materials and place in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
 - 1. 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.

3.14 CLEAN UP:

- A. Contractor shall remove any markings resulting from the work, from finished surfaces.
- B. He is to keep the roof and premises clean and free from accumulations of waste materials and rubbish at all times.
- C. He shall remove all debris, scrap, and rubbish from the work area daily.
- D. Surplus materials and all equipment shall be promptly removed from the site upon completion of the work.
- E. Prior to final acceptance, the Contractor shall restore all areas affected by his work to their original state of cleanliness and repair all damage done to the premises, by his workmen and equipment.

3.15 PROTECTION:

- A. General Contractor and Roofing subcontractor shall protect the finished roofing membrane at all times during and after roof installation.
 - 1. Provide temporary protective sheeting over uncovered deck surfaces.
 - 2. Turn sheeting up and over parapets and curbing. Retain sheeting in position with weights.
- B. No work, including staging or access to other portions of the work, shall be permitted on the finished membrane unless approved by the Owner.
- C. All roofing work shall commence at the furthest point from worker access and progress back towards the access point.
- D. If staging, access, or work is required on the finished membrane, the Contractor shall provide protection along the access path and under the work extending 48 inches beyond the required work area.
- E. Protection shall consist of 3/4 inch plywood over a heavy canvas tarp with sand bag ballasts as required to prevent the plywood from becoming airborne during strong winds.
- F. Provide for surface drainage from sheeting to existing drainage facilities.
- G. Do not permit traffic over unprotected or repaired deck surface.

END OF SECTION

PREPARATION FOR RE-ROOFING

SECTION 07213

BATT AND BLANKET INSULATION

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Batt insulation in interior construction.
 - B. Batt sound (acoustical) insulation.

1.2 RELATED SECTIONS:

- A. Section 05400 Cold Formed Metal Framing.
- B. Section 09260 Gypsum Board Systems.

1.3 REFERENCES:

- A. ASTM C665 Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- B. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- C. International Building Code (IBC), 2012 Edition.

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements
- B. Product Data: Provide manufacturer's product data on product characteristics and performance criteria

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS INSULATION MATERIALS:
 - A. CertainTeed.
 - B. Johns Manville (Schuller).
 - C. Owens-Corning.
 - D. Substitutions: See Section 01630 Product Substitutions.

2.2 BATT INSULATION MATERIALS

- A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; Type III, Class A, membrane faced batts in all plenum spaces, friction fit.
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.

BATT AND BLANKET INSULATION

- 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
- 4. Formaldehyde Content: Zero.
- 5. Thermal Resistance:
 - a. Roofs and Soffits R-30 min.
 - b. Walls R-19.
 - c. Thickness: as indicated on drawings.
 - d. Facing: Unfaced.
- B. Sound Attenuation Batts:
 - 1. Type: ASTM C665, type I; preformed fiberglass, friction fit type without integral vapor barrier membrane.
 - 2. Size:
 - a. Thickness: 3" (89mm), Width: 16" (406mm) or 24" (609mm), Length: 96" (2438mm).
 - 3. Surface Burning Characteristics:
 - a. Maximum flame spread: 10
 - b. Maximum smoke developed: 10
 - c. When tested in accordance with ASTM E 84.
 - 4. Combustion Characteristics:
 - a. Passes ASTM E 136.
 - 5. Fire Resistance Ratings:
 - a. Passes ASTM E 119 as part of a complete fire tested wall assembly.
 - 6. Sound Transmission Class: STC 45 min.
 - 7. Dimensional Stability:
 - a. Linear Shrinkage less than 0.1%.
- C. Tape, coated wire, or other devices for anchoring insulation shall be approved type furnished by the insulation manufacturer, or shall be of type recommended by the insulation manufacturer and accepted by the Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.
- B. Verify stud spacing for light gage metal framing specified in Section 09260 Gypsum Board Systems.

3.2 INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in spaces without gaps or voids.
- C. Trim insulation neatly to fit spaces.
- D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation. Leave no gaps or voids.
- E. Place acoustical insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions. Insulation scheduled to be wider than stud space shall be sliced 1 inch deep on the back to form a creased installation within the space.

BATT AND BLANKET INSULATION

END OF SECTION

BATT AND BLANKET INSULATION

SECTION 07620

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Counterflashing and reglets.
 - B. Flashing and counterflashings at equipment bases and roof hatches.
 - C. Pre-manufactured metal cap flashing.

1.2 RELATED SECTIONS:

A. Section 07533 – Single Ply Roofing.

1.3 REFERENCES

- A. ASTM A525 Steel Sheet, Zinc Coated by the Hot-Dip Process.
- B. ASTM A792 Steel Sheet, 55 Percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Shop Drawings:
 - 1. Indicates sizes, shapes, thicknesses and types of materials, finishes, fabrication details, anchors, connections, expansion joints and relation to adjacent work.
 - 2. Drawings shall be drawn to 1'' = 1' 0'' or larger scale.
- C. Product Data: Manufacturer's literature on factory fabricated items.

D. Samples:

- 1. Submit five (5), 12" square samples of the specified painted metal to be exposed as flashing or trim.
- 2. Samples shall be reviewed by the Owner for color and texture only.

1.5 QUALITY ASSURANCE:

A. Industry Standards: Architectural Sheet Metal Manual published by the Sheet Metal and Air Conditioning Contractors National Association, Inc., latest edition.

1.6 QUALIFICATIONS:

A. Applicator: Company specializing in sheet metal flashing work with five years minimum experience.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

SHEET METAL FLASHING AND TRIM

- A. Sheet metal: ASTM A525, minimum 24 gauge G90 hot-dipped galvanized steel smooth commercial grade.
- B. Fasteners:
 - 1. Fasteners shall be of same material or compatible with sheet metal being fastened.
 - 2. Rivets, screws and bolts shall be hard copper, brass or bronze except screws for aluminum shall be aluminum or stainless steel with exposed heads anodized to match sheets.
- C. Clad Metal Flashing:
 - 1. A PVC-coated, heat-weldable sheet metal capable of being formed into a variety of shapes and profiles. 24 gauge, G90 galvanized metal sheet with a 20 mil unsupported roof membrane laminated on one side.

2.2 FABRICATION:

- A. Fabrication Standard: Fabricate work as shown and to comply with SMACNA "Architectural Sheet Metal Manual".
- B. Units shall be of profile and dimensions shown on drawings complete with formed joint covers and flashing assembly and with prefabricated (mitered and solder) corner units.
- C. Provide for thermal expansion of running gutters and other items exposed for more than 15' -0" continuous length.
- D. Maintain a water tight seal at expansion joints.
- E. Locate expansion joints midway between drains, at high points in slopes, but in no case more than 30' -0" maximum spacing.

2.3 REGLETS:

- A. Where indicated on drawings all reglets installed shall be as manufactured by
 - 1. Fry Reglet Corporation (Basis of Design).
 - 2. Hickman Engineered Systems.
 - 3. Approved Equal.
- B. Surface Mounted Reglet: Type SM Springlok Flashing System.
- C. Concrete Reglet: Type CO Springlok Flashing System.
- D. All reglets shall be 24 gauge galvanized steel with standard zinc finish with 2" factory formed end lap at reglet and 3" lap at flashing.

PART 3 - EXECUTION

- 3.1 PREPARATION:
 - A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets in place.
 - B. Verify membrane termination and base flashings are in place, sealed, and secure.
 - C. Obtain field measurements prior to fabrication and installation.

SHEET METAL FLASHING AND TRIM

D. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION:

- A. Shop fabricate all items requiring soldering or welding, unless noted otherwise.
- B. Sheet metal work shall be of material and gauge specified, and shaped to install in strict conformance with details on drawings or on approved shop drawings.
- C. Form sheet metal work lines, arises, and angles sharp and true.
 - 1. Reinforce all metal flashing corners.
 - 2. Plane surfaces shall be free from waves or buckles.
- D. Mechanically fasten and solder all lap joints, splices, transitions, etc., which are not designed for expansion, contraction and watertightness.
- E. Fasten metal for strength by solid riveting, welding or forming double lock seams.
- F. All exposed metal edges are to be turned back into hemmed edge.
- G. Use elastomeric sealant where necessary to make a watertight installation, including foam backer rod where necessary to make a good sealant joint.
- H. Screw fasteners are to be turned into place rather than driven.
- I. Form all corner, transition and termination pieces as a single unit, and do not extend less than 4 inches nor more than 12 inches in any direction.
- J. All metal tie-in flanges for pipe flashings, etc. shall be at least 4 inches wide.
- K. Vertical counterflashing flanges shall be at least 3 inches wide unless otherwise specified.
- L. Soldering:
 - 1. Pre-trim edges of sheet metals before soldering is begun.
 - 2. Apply flux and begin soldering immediately.
 - 3. Soldering shall be done slowly with well heated soldering irons until the seams are thoroughly heated and the solder has been completely sweated through the full width of the seams.
 - 4. After soldering, all acid flux residue shall be removed with a solution of washing soda in water.
- M. Install pre-manufactured coping system in accordance with manufacturer's instructions and in configuration shown on drawings.

END OF SECTION

SECTION 07710

ROOF ACCESSORIES

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Manufactured curbs, equipment rails, and pedestals.
- 1.2 RELATED REQUIREMENTS:
 - A. Section 07620 Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.

1.3 REFERENCE STANDARDS:

- A. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- B. FM P7825 Approval Guide; Factory Mutual Research Corporation; current edition.
- C. MSS SP-58 Pipe Hangers and Supports Materials, Design, Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2009.
- D. UL (BMD) Building Materials Directory; current edition.

1.4 SUBMITTALS:

- A. See Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.
- C. Shop Drawings: Submit detailed layout developed for this project. Show dimensioned location and number for each type of roof accessory.
- 1.5 DELIVERY, STORAGE, AND HANDLING:
 - A. Store products in manufacturer's unopened packaging until ready for installation.
 - B. Store products under cover and elevated above grade.

PART 2 - PRODUCTS

- 2.1 MANUFACTURED CURBS:
 - A. Manufactured Curbs, Equipment Rails, and Other Roof Mounting Assemblies:
 - 1. AES Industries Inc.: www.aescurb.com.
 - 2. The Pate Company: www.patecurbs.com.
 - 3. Roof Products & Systems (RPS) by Commercial Products Group of Hart & Cooley, Inc.:

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www.rpscurbs.com.

- B. Manufactured Curbs, Equipment Rails, and Other Roof Mounting Assemblies: Factory-assembled hollow sheet metal construction with fully mitered and welded corners, integral counterflashing, internal reinforcing, and top side and edges formed to shed water.
 - 1. Sheet Metal: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33; G60 coating designation; 18 gage, 0.048 inch thick.
 - 2. Roofing Cants: Provide integral sheet metal roofing cants dimensioned to begin slope at top of roofing insulation; 1:1 slope; minimum cant height 4 inches.
 - 3. Manufacture curb bottom and mounting flanges for installation directly on roof deck, not on insulation; match slope and configuration of roof deck.
 - 4. Provide the layouts and configurations shown on the drawings.
- C. Curbs Adjacent to Roof Openings: Provide curb on all sides of opening, with top of curb horizontal for equipment mounting.
 - 1. Provide preservative treated wood nailers along top of curb.
 - 2. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.
 - 3. Height Above Finished Roof Surface: 6 inches, minimum.
 - 4. Height Above Roof Deck: 14 inches, minimum.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- 3.2 PREPARATION:
 - A. Clean surfaces thoroughly prior to installation.
 - B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- 3.3 INSTALLATION:
 - A. Install in accordance with manufacturer's instructions, in manner that maintains roofing weather integrity.
- 3.4 CLEANING:
 - A. Clean installed work to like-new condition.
- 3.5 PROTECTION:
 - A. Protect installed products until completion of project.
 - B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

ROOF ACCESSORIES

SECTION 07840 FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Through-penetration firestopping in fire rated wall and floor assemblies.
- B. Construction gap and joint firestopping within fire-rated walls and floors.
- C. Construction gap and joint firestopping at intersections of the same or different materials in firerated construction.
- D. Construction gap and joint firestopping at the top of fire-rated walls.
- E. Acoustical Fire Rated Outlet Backer Pads.
- F. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.2 REFERENCES:

- A. ASTM E84 Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials; 2014.
- C. ASTM E814 Test Method of Fire Tests of Through Penetration Firestops.
- D. ASTM E1966 Standard Test Method for Fire Resistive Joint Systems; 2007 (Reapproved 2011).
- E. ASTM E2174 Standard Practice for On-Site Inspection of Installed Firestops; 2014.
- F. ASTM E2393 Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2010a.
- G. ASTM E2307 10 Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus; 2010
- H. ASTM E2393 10a Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers
- I. ASTM G21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2013.
- J. FM (Factory Mutual Engineering Corporation) Fire Hazard Classifications.
- K. UL (Underwriters Laboratories, Inc.) Fire Resistance Directory.
 - 1. Through-Penetration Firstop Device (XHJI)
 - 2. Fire-Resistive Ratings (BXUV)
 - 3. Through-Penetration Firestop Systems (XHEZ)
 - 4. Fill, Void, or Cavity Material (XHHW)

FIRESTOPPING

- 5. Joint systems (XHBN)
- L. UL 2079 (Underwriters Laboratories, Inc.) Standard for Fire Tests of Joint Systems.
- M. WH (Warnock Hersey) Directory of Listed Products.
- N. South Coast Air Quality Management District, Rule #1168.
- O. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments
- P. International Building Code (IBC), 2012 Edition.

1.3 DEFINITIONS:

- A. Fire Rated Assembly: Includes all fire rated walls, floors floor/ceiling and roof system assemblies.
- B. Barriers: Time rated fire walls, smoke barrier walls, time rated ceiling/floor assemblies and structural floors.
- C. Firestopping: Use of a material or combination of materials to fill or seal openings in fire-rated assembly to restore the integrity of the assembly and prevent the spread of heat, fire gases and smoke.
- D. System: Specific products and applications, classified and numbered by Underwriter=s Laboratories, Inc. or other recognized testing laboratory, to seal openings in fire-rated assemblies.
- E. Penetration: An opening or object passing through or into a rated wall or floor that breaches the fire-rated assembly or smoke barrier.
- F. Construction Gaps: Any gap, joint or opening (static or dynamic) between adjacent sections of walls or floors, at wall topes between top of wall and ceiling, exterior walls and structural floors or roof decks. Where dynamic movement is required the system must comply with UL 2079.

1.4 PERFORMANCE REQUIREMENTS:

- A. Penetrations: Provide and install firestopping systems that are produced to resist the spread of fire, and the passage of smoke and other gases according to requirements indicated, including but not limited to the following:
 - 1. Firestop all penetrations passing through fire resistance rated wall and floor assemblies and other locations as indicated on the drawings.
 - 2. Provide and install complete penetration firestopping systems that have been tested and approved by third party testing agency.
 - 3. F Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined per ASTM E 814, but not less than one hour or the fire-resistance rating of the construction being penetrated.
 - 4. T Rated Through-Penetration Firestop Systems: Provide firestop systems with T ratings, in addition to F ratings, as determined per ASTM E 814, where indicated...
 - 5. L Rated Through-Penetration Firestop Systems: Provide firestop systems with L ratings, in addition to F and T ratings, as determined per UL 1479, where indicated.
 - 6. (Optional) W Rated Through-Penetration Firestop Systems: Provide firestop systems with W Water Resistance ratings, in addition to F, T and L ratings, as determined per UL 1479, where indicated.

FIRESTOPPING

- B. Perimeter Fire Containment Systems: Provide interior perimeter joint systems with fireresistance ratings indicated, as determined per ASTM E2307, but not less than the fireresistance rating of the floor construction.
- C. Fire-Resistive Joints: Provide joint systems with fire-resistance ratings indicated, as determined per UL 2079, but not less than the fire-resistance rating of the construction in which the joint occurs.
- D. For firestopping exposed to view, traffic, moisture, and physical damage, provide firestop systems for these conditions that meet conditions expected as communicated through construction documents.
- E. Where there is no specific third party tested and listed, classified firestop system available for a particular firestop configuration, the firestopping contractor shall obtain from the firestop manufacturer, an Current Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA) for submittal.

1.7 SUBMITTALS

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: Provide data on material characteristics and performance.
- C. Schedule of Firestopping: Provide a list each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
 - 1. All approved firestopping assemblies including engineering judgments shall be provided and organized by trade.
- D. Manufacturer's Systems Manual: Provide current manufacturer's data on all firestopping systems approved by regulatory agencies including materials, barriers, rating limitations and installation instructions of the various products required to comply with established code provisions.
- E. General Contractor shall be responsible for assembling of information involving firestopping systems from all trades and making one submittal which shall encompass all firestopping to be used on the Project. Provide full submittal in a tabbed binder with index.

1.8 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with ASTM E814, ASTM E119, ASTM 1479, ASTM E2307, and UL 2079.
 - 1. Listing in the current-year classification or certification books of UL, FM, or ITS (Warnock Hersey) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icces.org will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. For those firestop applications that exist for which no qualified tested system is available through a manufacturer, an engineering judgment derived from similar qualified tested system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment documents must follow requirements set forth by the International Firestop Council.
- C. Single Source Responsibility: Obtain firestop systems for each kind of penetration and

construction condition indicated from a single primary firestop systems manufacturer.

- 1. Materials of different manufacture than allowed by the tested and listed system shall not be intermixed in the same firestop system or opening.
- 2. Tested and listed, classified firestop systems are to be used. If another manufacturer has a tested and listed system, then that system shall be used prior to an Engineering Judgment (EJ) or Equivalent Fire Resistance Rated Assembly (EFRRA).
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience.
- E. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Trained by the direct representative of the manufacturer.
 - 2. Approved by Factory Mutual Research under FM Standard 4991, Approval of Firestop Contractors, Underwriters Laboratories (UL) Approved Contractor, or meeting any two of the following requirements:.
 - a. With minimum 5 years documented experience installing work of this type.
 - b. Able to show at least 5 satisfactorily completed projects of comparable size and type.
 - c. Licensed by authority having jurisdiction.

1.9 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.
 - 1. 3M Fire Protection Products: www.3m.com/firestop
 - 2. Hilti, Inc.: www.us.hilti.co; 800-879-8000.
 - 3. Specified Technologies.
- B. Substitutions: See Section 01630 Product Substitutions.
- 2.2 FIRESTOPPING GENERAL REQUIREMENTS
 - A. Firestopping: Any material meeting requirements.
 - B. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
 - C. Materials: Use any material meeting requirements.
 - D. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing

agency for the designated fire-resistance-rated systems.

- E. Firestopping Materials with Volatile Content: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.
- F. Mold Resistance: Provide firestopping materials with mold and mildew resistance rating of 0 as determined by ASTM G21.
- G. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.
- H. Fire Ratings: Refer to Drawings for required systems and ratings.
- I. Firestop materials and systems for use in construction gap and joint firestopping of fire-rated construction shall be rated for installation in dynamic (movement) type gap/joint situations in accordance with UL 2079 and IBC.

2.3 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Perimeter Fire Containment Firestopping: Use any system that has been tested according to ASTM E 2307 to have fire resistance F Rating equal to required fire rating of the floor assembly.
 - 1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
 - 2. Temperature Rise: In addition, provide systems that have been tested to show T Rating as indicated.
 - 3. Air Leakage: In addition, provide systems that have been tested to show L Rating as indicated.
 - 4. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated.
- B. Head-of-Wall Firestopping at Joints Between Non-Rated Floor and Fire-Rated Wall: Use any system that has been tested according to ASTM E 2079 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
 - 1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
- C. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use any system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
 - 1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
 - 2. Air Leakage: In addition, provide systems that have been tested to show L Rating as indicated.
 - 3. Watertightness: In addition, provide systems that have been tested to show W Rating as indicated.
 - 4. Listing by UL, FM, or Intertek in their certification directory will be considered evidence of successful testing.
- D. Through Penetration Firestopping: Use any system that has been tested according to ASTM E 814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
 - 1. Temperature Rise: In addition, provide systems that have been tested to show T Rating as indicated.
 - 2. Air Leakage: In addition, provide systems that have been tested to show L Rating as indicated on drawings.
 - 3. Watertightness: In addition, provide systems that have been tested to show W Rating as

indicated on drawings.

- 4. Listing by UL, FM, or Intertek in their certification directory will be considered evidence of successful testing.
- 2.4 FIRESTOPPING SYSTEMS
 - A. Firestopping: Any material meeting requirements.
 - 1. Fire Ratings: Use any system listed by UL or that has F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and that meets all other specified requirements.
- 2.5 ACOUSTICAL FIRE-RATED PUTTY PADS:
 - A. Use only backer pads that have been UL 1479 or ASTM E-814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, and fire-rating involved for each separate instance.
 - B. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:
 - 1. Kinetics Noise Control Model IsoBacker: Acoustical Fire Rated Outlet Backer Pad.
 - C. Manufacturers:
 - 1. Kinetics Noise Control, Dublin OH; 877-457-2695.
 - 2. 3M Fire Barrier Moldable Putty; 3M Fire Protection Products

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify requirements for firestopping for each condition encountered during the course of construction whether shown on drawings or created by the sequence of the Work.
- B. Verify that openings are ready to receive the Work of this Section.
- C. Provide one copy of approved Manufacture's Systems Manual on-site at start of construction and ensure manual remains on-site and available to all trades and inspectors during the entire course of the Work.

3.2 PREPARATION:

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may effect bond of firestopping material.
- B. Remove incompatible materials which affect bond.
- C. Install backing materials to arrest liquid material leakage.
- D. Comply with all area and material preparation requirements imposed by the manufacturer and the regulatory agency establishing the designated rating.
- E. Sequence work of this section to permit firestopping materials to be installed after adjacent and surrounding work is complete.
- F. At horizontal cuts required for pipe penetrations, comply with the following:
 1. Multiple Pipe Penetrations: Horizontal cuts will be backed. This backing will be required

to the point that upon pushing the drywall around the pipe penetrations, the drywall is fixed firmly in place.

- 2. Moderate contact of all horizontal joints is required.
- 3. Less than 2 inch Pipe/Single Penetrations; Additional backing will not be required of the horizontal cut to encircle the pipe. Note that moderate contact of the drywall boards must be maintained to not require additional backing.
- 4. Greater than 2 inch Pipe/Single Penetration: Additional backing will be required of the horizontal cut to encircle the pipe.

3.3 APPLICATION

- A. Seal holes: or voids made by penetrating items to requirements of the original fire and smoke rating of the assembly.
- B. Seal all intersections and penetrations of floors, ceilings walls and columns. This includes intersection of rated construction with adjacent construction.
- C. Seal around all cutouts for electrical, mechanical, plumbing and other work that penetrates fire and/or smoke rated construction assemblies
- D. General: Install firestopping materials to comply with firestopping system manufacturer's written installation instructions and published drawings for products and applications indicated.
- E. Apply primer and materials in accordance with manufacturer's instructions.
- F. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
- G. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping system.
- H. Install fill materials for firestopping systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
- I. Apply firestopping material in location and sufficient thickness to achieve rating.
- J. Install protective material such as sheet metal, gypsum board or other approved materials required to meet the system rating.
- K. Tool all sealant type materials concave unless prohibited by rating requirements.

3.4 FIELD QUALITY CONTROL

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- B. Keep areas of work accessible until inspection by applicable code authorities.
- C. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E

2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" and ASTM E 2393 - 10a Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers. Inspection agency to examine firestopping and will determine, in general that firestopping has been installed in compliance with requirements of tested and listed firestop systems, and installation process conforms to FM 4911 - Standard for Approval of Firestop Contractors.

- 1. The Inspector shall advise the Contractor of any deficiencies noted within one (1) working day.
- 2. Do not proceed to enclose firestopping with other construction until inspection agency has verified that the firestop installation complies with the requirements.
- 3. Where deficiencies are found, repair or replace the firestopping so that it complies with requirements of tested and listed systems.
- D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.
- E. Manufacturer's Field Services: During Installation, provide periodic destructive testing inspections to assure proper installation/application. After installation is complete, submit findings in writing indicating whether or not the installation of the tested system identified was installed correctly.

3.5 IDENTIFICATION & DOCUMENTATION

- A. The firestop contractor is to supply documentation for each single application addressed. This documentation is to identify each penetration and joint location on the entire project.
- B. The Documentation Form for Through Penetrations is to include:
 - 1. A Sequential Location Number
 - 2. The Project Name
 - 3. Date of Installation
 - 4. Detailed description of the penetrations location
 - 5. Tested System or Engineered Judgment Number
 - 6. Type of assembly penetrated
 - 7. A detailed description of the size and type of penetrating item
 - 8. Size of opening
 - 9. Number of sides of assemblies addressed
 - 10. Hourly rating to be achieved
 - 11. Installers Name
- C. The Documentation Form for Construction Joints is to include:
 - 1. A Sequential Location Number
 - 2. The Project Name
 - 3. Date of Installation
 - 4. Detailed description of the Construction Joints location
 - 5. Tested System or Engineered Judgment Number
 - 6. Type of Construction Joint
 - 7. The Width of the Joint
 - 8. The Lineal Footage of the Joint
 - 9. Number of sides addressed
 - 10. Hourly rating to be achieved
 - 11. Installers Name
- D. Copies of these documents are to be provided to the general contractor at the completion of the project.
- E. Penetration Identification: Identify through-penetration firestop systems with pressure-sensitive,
self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

- 1. The words: "Warning -Through Penetration Firestop System-Do Not Disturb. Notify Building Management of Any Damage."
 - a. Contractor's Name, address, and phone number.
- 2. Through-Penetration firestop system designation of applicable testing and inspecting agency.
- 3. Date of Installation.
- 4. Through-Penetration firestop system manufacturer's name.
- 5. Installer's Name.
- F. Wall Identification: All marking and identification of firewalls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be effectively and permanently identified with signs or stenciling and shall meet the following requirements:
 - 1. Be in full compliance with Section 703.7 of the International Building Code; 2012.
 - 2. Be located in accessible concealed floor, floor-ceiling or attic spaces.
 - a. Height above the ceiling: From 6" to 12".
 - b. Both Sides of the wall
 - 3. Be located within 15 feet (4572 mm) of the end of each wall and at intervals not exceeding 30 feet (9144 mm) measured horizontally along the wall or partition;
 - 4. Include lettering not less than 3 inch (76 mm) in height, with a minimum 3/8 inch (9.5 mm) stroke in a contrasting color incorporating the suggested wording: "FIRE AND/OR SMOKE BARRIER-PROTECT ALL OPENINGS," or other wording indicating type of wall or partition.
 - a. Color: bright orange or red.

3.6 CLEANING

- A. Clean adjacent surfaces of firestopping materials.
- B. Trim firestopping materials and barrier materials from adjacent surfaces.

3.7 PROTECTION

A. Protect adjacent surfaces from damage by material and system installation.

END OF SECTION

FIRESTOPPING

SECTION 07900

JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Joint preparation, priming, backing materials, and weatherseal sealants for exterior and interior wall applications, and accessories indicated, specified, or required to complete application.

1.2 RELATED SECTIONS:

- A. Section 07840 Firestopping: Sealants used in firestopping systems.
- B. Section 08800 Glazing: Sealants used in glazing.
- C. Section 09260 Gypsum Board Systems: Acoustical sealants.

1.3 PERFORMANCE REQUIREMENTS:

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and waterresistant continuous joint seals without staining or deteriorating joint substrates.

1.4 REFERENCES:

- A. AAMA 800-10 Voluntary Specifications and Test Methods for Sealants
- B. ASTM C834 Standard Specification for Latex Sealants; 2010.
- C. ASTM C919 Standard Practice for Use of Sealants in Acoustical Applications; 2012
- D. ASTM C920 Standard Specification for Elastomeric Joint Sealants; 2014.
- E. ASTM C1193 Standard Guide for Use of Joint Sealants; 2013.
- F. ASTM D1667 Standard Specification for Flexible Cellular Materials Poly (Vinyl Chloride) Foam (Closed-Cell).

1.5 SUBMITTALS

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: For each joint-sealant product indicated; submit:
 - 1. Manufacturer's technical literature for each product indicated, specified, or required; sealant chemical characteristics, performance criteria, substrate preparation, limitations.
 - 2. Color selection charts. Architect's acceptance will be for color only.
 - 3. Procedures for priming, backing, installing, tooling, and curing for each type of sealant and each joint condition.
 - 4. Instructions for handling, storage, mixing, and protection of each type of sealant.
- C. Manufacturer's Installation Instructions: Submit special procedures, surface preparation, and

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perimeter conditions requiring special attention.

1.6 QUALITY ASSURANCE:

- A. The Contractor assumes undivided responsibility for the selection, installation and performance of the materials as described above and herein.
 - 1. Compatibility: Sealants, backings, and accessories shall be compatible with one another, within exterior wall systems and with sealants and materials used by other trades under conditions of service and application.
 - 2. Joint sealants are required to establish and maintain weather tight continuous seals on a permanent basis, with recognized limitations of wear and aging as indicated for each application.
- B. Manufacturer Qualifications: Company with not less than 10 years experience in manufacturing products similar to scope of this Project with a record of successful in-service performance
- C. Manufacturers Technical Representative Qualifications: Direct employee of technical services department of manufacturer with minimum of 5 years experience in providing recommendations, observations, evaluations, and problem diagnostics. Sales representatives are not acceptable
- D. Installer Qualifications: Company specializing in performing work of this section with minimum five (5) years experience.
- E. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.7 PROJECT CONDITIONS:

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

- 2.1 MATERIALS, GENERAL
 - A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
 - B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.
 - 2. Non-membrane Roof Sealants: 300 g/L.
 - 3. Single-Ply Roof Membrane Sealants: 450 g/L.
 - 4. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 5. Sealant Primers for Porous Substrates: 775 g/L.
 - 6. Modified Bituminous Sealant Primers: 500 g/L.

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C. Colors of Exposed Joint Sealants: As selected by Architect/Engineer from manufacturer's full range.

2.2 MANUFACTURERS

- A. Manufacturers:
 - 1. Sonneborn
 - 2. Tremco
 - 3. Sika Corp.
 - 4. Pecora
 - 5. Dow Corning Corp.
 - 6. G.E.
- B. Substitutions: See Section 01630 Product Substitutions.

2.3 JOINT SEALERS

- A. Concrete: Horizontal:
 - 1. Two-part Polyurethane, self-leveling.
 - 2. ASTM C920, Type M, Grade P, Class 25, Use T and M.
 - 3. Movement: Plus or minus 25 percent
 - 4. Shore A Hardness: 25
 - 5. Color as selected by Architect from manufacturer's full line of standard colors. More than one color may be selected.
 - 6. Sonneborn "MasterSeal SL-2".
 - 7. Tremco "THC-900/THC-901".
 - 8. Sika "Sikaflex 2C-SL"
 - 9. Pecora "NR-200 Urexpan"
- B. Interior:
 - 1. Acrylic latex
 - 2. ASTM C834, Paintable.
 - 3. Color as selected by Architect from manufacturer's full line of standard colors. More than one color may be selected.
 - 4. Tremco "Tremflex 834"
 - 5. Pecora "AC-20 + Silicone"
- C. Restrooms/Counters/Fixtures/Other Wet Locations:
 - 1. Acetoxy Silicone/Silicone
 - 2. ASTM C920, Type S, Grade NS, Class 25, Use NT, G and A.
 - 3. Recommended by manufacturer for use in restrooms and other wet areas, and as not supporting growth of fungus/bacteria.
 - 4. Movement: Plus or minus 25 percent
 - 5. Color as selected by Architect from manufacturer's full line of standard colors. More than one color may be selected.
 - 6. Pecora "898 Silicone Sanitary Sealant"
 - 7. Dow Corning "Dow 786 Mildew Resistant Silicone Sealant"
 - 8. G.E. "1700 Sanitary Silicone Sealant"
- 2.4 ACCESSORIES:
 - A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
 - B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

- C. Joint Backing: Round foam rod compatible with sealant; ASTM D1330, closed cell material with a surface skin) oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS:

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow

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optimum sealant movement capability.

- F. Tooling of Nonsag Sealants:
 - 1. Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 2. Remove excess sealant from surfaces adjacent to joints.
 - 3. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- G. Provide concave joint configuration unless otherwise indicated.
 - 1. Provide flush joint configuration where indicated.
- H. Installation of Preformed Tapes: Install according to manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL:

- A. Field Inspection:
 - 1. Sealant Manufacturer representative shall inspect first day's work and periodically inspect work to ensure application is proceeding in accordance with manufacturer's designs, recommendations, instructions and warranty requirements. Submit written reports of each visit.
 - 2. State if installation methods complied with the manufacturer's printed instructions and their field representative's verbal instructions and were proper and adequate for the condition of installation and use.
- B. Field Adhesion and Cohesion Testing: Sealant manufacturer representative will perform a minimum of 20 field tests to determine if installed work complies with specified requirements. Tests to be witnessed by Owner, Architect. Test sealant after it has fully cured (7-21 days).
 - 1. Destructive Cut and Pull Test.
 - 2. Provide testing as follows to demonstrate curing properties:
 - a. Between 24 and 72 hours prior to initial application.
 - b. Prior to use of each new shipment of materials.
 - c. Not less than twice a month for existing stored materials.
- C. Reports: Record test results and prepare reports according to ASTM E575 and ASTM C1521 formats.
- D. Re-testing and Re-inspections Due to Failures:
 - 1. Perform further testing to ascertain the extent of the problem. All failed sealants are to be replaced promptly and the resulting weather tightness must be verified.
 - 2. Remove from site marginal or defective material.
 - 3. Contractor responsible for expenses incurred, without additional cost to Owner, due to failure of work to pass testing and inspections.
- E. Repairs for Destructive Testing:
 - 1. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints.
 - 2. Ensure original sealant surfaces are clean and new sealant properly contacts original sealant.

3.5 CLEANING:

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and

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of products in which joints occur.

3.6 PROTECTION:

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion.
- B. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 POST-OCCUPANCY:

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at the low temperature in the thermal cycle. Report failures immediately and repair.

END OF SECTION

SECTION 08111

HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Standard hollow metal frames.
- 1.2 RELATED REQUIREMENTS:
 - A. Section 08211- Flush Wood Doors for wood doors installed in hollow-metal frames.
 - B. Section 08710 Door Hardware for electrified hardware.

1.3 DEFINITIONS:

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION:

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate Owner approved concealed plug connectors to interface with electric hardware on the end of the wiring harness to plug directly into specified electrified hardware and the electric hinge. Refer to Section 08710 Door Hardware.

1.5 PREINSTALLATION MEETINGS:

A. Preinstallation Conference: Conduct conference at Project site.

1.6 SUBMITTALS:

- A. Product Data: For each type of product.
 - 1. For each type of product indicated. Include construction details, material descriptions, core descriptions, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 2. Locations of reinforcement and preparations for hardware.
 - 3. Details of each different wall opening condition.
 - 4. Details of anchorages, joints, field splices, and connections.
 - 5. Details of moldings, removable stops, and glazing.
 - 6. Details of conduit and preparations for power, signal, and control systems.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: Prepare Samples to demonstrate compliance with requirements for

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quality of materials and construction. Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

- E. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.
- F. Product Test Reports: For each type of frame assembly, for tests performed by a gualified testing agency.
- G. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.
- 1.7 DELIVERY, STORAGE, AND HANDLING:
 - Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit Α. and Project-site storage. Do not use nonvented plastic.
 - Provide additional protection to prevent damage to factory-finished units. 1.
 - Β. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
 - C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each unit to permit air circulation.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS:
 - Α. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.
 - Approved Steel Doors and Frames: 1.
 - a. Assa Abloy Ceco, Curries, or Fleming: www.assaabloydss.com.
 - Β. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed. Source Limitations: Obtain hollow-metal work from single source from single manufacturer. 1.
 - Acceptable Manufacturers:
 - Republic Doors: www.republicdoor.com. a.
 - Steelcraft, an Allegion brand: www.allegion.com/us. b.
 - Substitutions: See Section 01630 Product Substitutions. C.

2.2 **INTERIOR FRAMES:**

- Construct interior frames to comply with the standards indicated for materials, fabrication, hard-Α. ware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- Β. Standard-Duty Frames: SDI A250.8, Level 1. At locations indicated in the Door and Frame Schedule.
 - 1. Physical Performance: Level C according to SDI A250.4.
 - 2. Materials: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0

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mm).

- 3. Construction: Full profile welded.
- 4. Exposed Finish: Prime.

2.3 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
 - 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
 - 4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-(9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.4 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- E. Frame Anchors: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
 - 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M, hot-dip galvanized according to ASTM A153/A153M, Class B.
- F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- H. Grout: ASTM C476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C143/C143M.
- I. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing

ASTM E136 for combustion characteristics.

- J. Glazing: Comply with requirements in Section 08800 "Glazing."
- K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 - 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 - 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
 - Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above <u>96 inches</u> (2438 mm) high.
 - c. Compression Type: Not less than two anchors in each frame.
 - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
 - 1) Head Anchors: Two anchors per head for frames more than 42 inches (1067 mm) wide and mounted in metal-stud partitions.
 - 2) Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - e. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - f. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
 - 6. Terminated Stops: Terminate stops 6 inches (152 mm) above finish floor with a 45 -

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degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

- 7. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.
- C. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce frames to receive nontemplated, mortised, and surface-mounted hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
 - Provide all hollow metal frames to receive electrified hardware with Owner approved electric hardware wiring harnesses and concealed plug connectors. Refer to Section 08710 – Door Hardware.
- D. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior frames.
 - 4. Provide loose stops and moldings on inside of hollow-metal work.
 - 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.6 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
- B. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with SDI A250.3.
 Color and Gloss: As indicated by manufacturer's designations.

2.7 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap frames to receive nontemplated, mortised, and surface-mounted hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of
 - postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 - 5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
 - 8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.

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- c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
- d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Glazing: Comply with installation requirements in Section 08800 "Glazing" and with hollowmetal manufacturer's written instructions.
 - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
- F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

SECTION 08212

FLUSH WOOD DOORS

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Non-rated flush wood doors.
 - B. Transom panels.

1.2 RELATED REQUIREMENTS:

- A. Section 08111 Hollow Metal Frames.
- B. Section 08710 Door Hardware.
- C. Section 08800 Glazing.
- D. Section 09900 Painting and Coating: Field finishing of doors.

1.3 REFERENCES:

- A. WDMA Window and Door Manufacturers Association: IS 1-A 2011 Industry Standard for Architectural Flush Wood Doors.
- B. AWI Quality Standards of Architectural Woodwork Institute.
- C. International Building Code (IBC), 2012 Edition.

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.
- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate requirements for veneer matching.
 - 4. Indicate doors to be factory finished and finish requirements.
 - 5. Indicate fire-protection ratings for fire-rated doors.
- D. Samples: Submit five (5) samples of door veneer illustrating wood facing and finish.

1.5 QUALITY ASSURANCE:

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum (10) ten years of documented experience.
- B. Source Limitations: Obtain flush wood doors from single manufacturer.

- C. All work of this section shall be manufactured in accordance with the latest edition of the Architectural Woodwork Standards (AWS) and shall be AWS "Custom" Grade.
- D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL 10C.
- 1.6 DELIVERY, STORAGE AND HANDLING:
 - Α. Comply with requirements of AWS, Section 2 – Care & Storage.
 - Β. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
 - Mark each door on top rail with opening number used on Shop Drawings. C.

1.7 WARRANTY:

- Provide manufacturer's "life of installation" warranty. Α.
 - Interior Doors: Provide manufacturer's warranty for the life of the installation. 1.
 - 2. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.
 - 3. Include removal of the defective door, hanging, hardware installation, finishing and labeling as required.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS:
 - Basis of Design: Contract Documents are based on products specified below to establish a Α. standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect. 1.
 - Approved Manufacturers:
 - a. Marshfield Door Systems, Inc.: www.marshfielddoors.com.
 - Β. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents. provide product by one of manufacturers listed alphabetically below. If not listed. Submit as substitution according to Conditions of the Contract and Division 1 Sections.
 - VT Industries, Inc.: www.vtindustries.com. 1.
 - Eggers Industries: www.eggersindustries.com. 2.
 - 3. Algoma: www.algomahardwoods.com
 - Substitutions: See Section 01630 Product Substitutions. C.

2.2 DOOR CONSTRUCTION, GENERAL:

- All Doors: See drawings for locations and additional requirements. Α.
 - Quality Level: Premium Grade, Standard Duty performance, in accordance with WDMA 1. I.S. 1A.
 - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
 - 3. Thickness: 1-3/4 inches, interior flush wood,
 - Wide stile entrance doors. 4.
 - 5-1/2 inch stiles, 5-1/2 inch top rail and 10 inch bottom rail. Door size as scheduled. 5.
- Β. Provide flush interior, rated and non-rated solid core wood doors as shown on the door

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schedule.

- C. Core: Solid Core material. Core material may include stave wood, particleboard, agrifiber construction.
- D. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fireprotection rating indicated.
- E. Facing: Quarter sliced, running match select white maple, uniform color and grain for transparent finish.
- F. Glazing Stops: Steel glazing stops with mitered corners attached with countersunk style screws. Prime paint stops for field finishing.
- G. Certified Wood: Fabricate doors with cores not less than 70 percent of wood products produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- H. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.
- I. Low-Emitting Materials: Fabricate doors with adhesives that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 DESIGN CLEARANCES

- A. The clearance between the door and frame head and jambs shall be 1/8" (3.2 mm) in the case of both single swing and pairs of doors.
- B. The clearance between the meeting edges of pairs of doors shall be 1/8" (3.2 mm) to 1/4" (6.3 mm), for fire rated doors 1/8" (3.2 mm) ± 1/16" (1.6 mm).
- C. The clearance at the bottom shall be 3/8" (9.25 mm) above finish floor, ½" (12.7 mm) at doors with Auto Door Bottom seals.
- D. The clearance between the face of the door and door stop shall be 1/16" (1.6 mm) to 1/8" (3.2 mm).
- E. All clearances shall be, unless otherwise specified, subject to a tolerance of ± 1/32" (0.8 mm).

2.4 FLUSH DOOR FABRICATION:

- A. Fabricate doors in accordance with AWS Quality Standards.
- B. Grade: Doors constructed to standards of AWS Section 9 Doors, "Custom" Grade, Type PC-5; five-ply construction.
 - 1. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- C. Provide lock blocks at lock edge and top of door for closer. Provide solid block for all surface mounted hardware.
- D. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions.

- E. Provide edge strips of wood species to match face veneer.
- F. Seal door top edge with transparent wood sealer to match door facing.

2.5 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: match existing, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
 - 1. Vertical Edges: Same species as face veneer.
 - 2. "Running Match" each pair of doors and doors in close proximity to each other.
 - 3. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.

2.6 ACCESSORIES:

- A. Vision Frames;
 - 1. Non-rated doors: Flush wood frames, hardwood to match facing.
 - 2. Glazing: Refer to Section 08800 Glazing, for glass types.
 - 3. Glazing Stops: Wood, of same species as door facing, mitered corners; prepared for countersink style tamper proof screws.

2.7 FINISH:

- A. Factory finish doors in accordance with AWS Section 5 Finishing.
- B. Provide AWS Finish System 11, Catalyzed Polyurethane; "Custom" Grade.
- C. Provide stain color and sheen approved by Architect.
- D. All finish products shall not exceed the VOC limits established in South Coast Air Quality Management District (SCAQMD), Rule 1113, Architectural Coatings, rules in effect on January 1, 2004 (EQ Credit 4.2).

PART 3 - EXECUTION

- 3.1 INSTALLATION:
 - A. Install doors in accordance with manufacturer's instructions.
 - B. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
 - C. Machine cut relief for hinges and closers and coring for handsets and cylinders.
 - D. To the greatest extent possible, factory (shop) prepare doors for hardware
 - E. Pilot drill screw and bolt holes.
 - F. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
 - G. Field-Finished Doors: Trimming to fit is acceptable.
 - 1. Adjust width of non-rated doors by cutting equally on both jamb edges. Trim fire door width from lock edge only, to a maximum of 3/16 inch.
 - 2. Trim maximum of 1/2 inch off bottom edges unless otherwise required.
 - 3. Trim fire-rated doors in strict compliance with fire rating limitations.

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- 4. Trim door height by cutting equally on top and bottom edges to a maximum of 3/4 inch. Trim fire door height at bottom edge only, to a maximum of one inch.
- H. Coordinate installation of doors with installation of frames and hardware.
- I. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
- J. Coordinate installation of glass and glazing as specified in Section 08800 Glazing.

3.2 TOLERANCES:

- A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.
- B. Door Clearances: edge clearance 1/8", top clearance 1/8", bottom clearance 1/8" above decorative floor covering or 1/4" above threshold. Top and side clearances equal and parallel to frame.
- C. Conform to specified quality standard for telegraphing, warp, and squareness.

3.3 ADJUSTING:

- A. Adjust for smooth and balanced door movement.
- B. Adjust closers for full closure.
- C. Operation: Rehang or replace doors that do not swing or operate freely.
- D. Finished Doors: Replace doors that are damaged or that do not comply with requirements.
- E. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 08305

ACCESS DOORS AND PANELS

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Fire resistive rated and non-rated access doors and frames.
 - B. Provide ceiling and wall access doors as shown on the drawings.
 - C. Provide additional access doors where required for access to concealed equipment and ceiling spaces with no other means of access.
- 1.2 RELATED SECTIONS:
 - A. Section 09260 Gypsum Board Systems.
 - B. Section 09900 Painting.
 - C. Division 15 Mechanical.
 - D. Division 16 Electrical.

1.3 REFERENCES:

- A. Underwriters Laboratories, Inc. (UL).
- B. NFPA 80 Standard for Fire Doors and Other Opening Protectives; current edition.
- C. International Building Code (IBC), 2012 Edition.

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: Include sizes, types, finishes, scheduled locations, and details of mounting to adjacent work.
- C. Shop Drawings: Provide Drawings indicating exact position of all access door units.
 - 1. General: Show connections of units and hardware to other Work. Include schedules showing location of each type and size of door and panel units.
 - 2. Door and panel units: Show types, elevations, thickness of metals, full size profiles of door members.
 - 3. Hardware: Show materials, finishes, locations of fasteners, types of fasteners, locations and types of operating hardware, and details of installation

1.5 QUALITY ASSURANCE:

- A. Single Source Responsibility: Obtain access door and panel units, and frames for entire Project from 1 source and 1 single manufacturer.
- B. Size Variations: Obtain Architect's acceptance and approval of manufacturer's standard size

units that may vary slightly from sizes indicated on Drawings.

C. Coordination: Provide inserts and anchoring devices that will be built into other Work for installation of access door assemblies. Coordinate delivery with other Work to avoid delay.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.
 - 1. Approved Manufacturers:
 - a. Babcock-Davis: www.babcockdavis.com
 - b. J. L. Industries: www.jlindustries.com.
 - c. Karp Associates.
 - d. Milcor by Commercial Products Group of Hart & Cooley, Inc.: www.milcorinc.com.
 - e. Acudor.
 - f. Bilco Co.
- B. Substitutions: See Section 01630 Product Substitutions.

2.2 ACCESS PANELS – GENERAL:

- A. Access Doors: Factory fabricated door and frame units, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies that units are to be installed in.
 - 1. Material: Steel.
 - 2. Style: Exposed frame with door surface flush with frame surface.
 - 3. In Gypsum Board: Use drywall bead type frame.
 - 4. In Plaster: Use plaster bead type frame.
 - 5. Door Style: Single thickness with rolled or turned in edges.
 - a. Fourteen (14) gage steel.
 - 6. Frames: 16 gage, 0.0598 inch, minimum., welded construction
 - 7. Heavy Duty Frames: 14 gage, 0.0747 inch, minimum.
 - 8. Single Thickness Steel Door Panels: 1/16 inch, minimum.
 - 9. Heavy Duty Single Thickness Steel Door Panels: 14 gage, 0.0747 inch, minimum.
 - 10. Double-Skinned Hollow Steel Door Panels: 16 gage, 0.059 inch, minimum, on both sides and each edge.
 - 11. Door Panels to Receive Wall/Ceiling Finish: Surface recessed 5/8 inch back from wall face.
 - 12. Insulation: Non-combustible mineral or glass fiber.
- B. Hinges: Continuous, concealed, zinc plated.
- C. Lock: Custom cylinder lock, 6 pin, key all doors alike, provide two keys for each doors.
- D. Provide spring assist lever and positive latch for all ceiling access doors exceeding 16 inches square.
- E. Fabricate access panels for installation in rated walls and ceilings in accordance with requirements of the rating approval.

F. Provide stainless steel construction for doors in showers and service areas including janitorial rooms, mechanical rooms and spaces.

PART 3 - EXECUTION

- 3.1 EXAMINATION:
 - A. Verify locations and sizes of access panels required.
 - B. Verify rough openings for door and frame are correctly sized and located.
 - C. Verify location and orientation of equipment or controls requiring access.
 - D. Beginning of installation means acceptance of existing conditions.
 - E. Verify mechanical and electrical requirements for ceiling or wall access panels.

3.2 INSTALLATION:

- A. Install units in accordance with the manufacturer's instructions.
- B. Install fire rated units in accordance with requirements established by the rating agency.
- C. Install frame plumb and level in wall and ceiling openings.
- D. Install ceiling mounted frames square and parallel with adjacent walls and on axis of room or space. Center openings in corridor ceilings unless noted otherwise.
- E. Position to provide convenient access to concealed work requiring access.
- F. Secure rigidly in place in accordance with manufacturer's instructions.

3.3 ADJUST AND CLEAN:

- A. Adjust panel after installation for proper operation.
- B. Remove and replace panels or frames that are warped, bowed, or damaged.

END OF SECTION

SECTION 08411

ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Aluminum door and frames.
 - B. Interior aluminum storefront.
- 1.2 RELATED REQUIREMENTS:
 - A. Section 05500 Metal Fabrications: Steel attachment devices.
 - B. Section 07900 Joint Sealers.
 - C. Section 08710 Door Hardware: Hardware items other than specified in this section.
 - D. Section 08800 Glazing: Glass and glazing accessories.
- 1.3 SYSTEM DESCRIPTION:
 - A. Aluminum entrances and storefront system includes:
 - 1. Self-supporting, reinforced, tubular aluminum sections.
 - 2. Sections shall be shop fabricated and factory pre-finished.
 - 3. System includes related flashings, anchorage and attachment devices.
 - 4. System layout shall be as shown on drawings including custom and non-standard configurations.
 - B. Door hardware and glazing are specified in other Division 8 sections.

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: Provide component dimensions; describe components within assembly, anchorage and fasteners, hardware reinforcing and internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, anticipated deflection under load, affected related Work and expansion and contraction joint location and details.
- D. Submit four (4) samples 6 inches in size illustrating pre-finished aluminum surface.
- E. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.5 QUALITY ASSURANCE:
 - A. Source Limitations: Obtain aluminum framed storefront system through one source from a single manufacturer.

- B. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Nevada.
- C. Manufacturer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum ten (10) years of documented experience.
- D. Installer Qualifications: An installer which has had successful experience with installation of the same or similar units required for the project systems with minimum five (5) years of documented experience.
- E. Perform Work in accordance with AAMA SFM-1 and AAMA Metal Curtain Wall, Window, Store Front and Entrance Guide Specifications Manual and AAMA Aluminum Curtain Wall Design Guide Manual.
- 1.6 DELIVERY, STORAGE, AND HANDLING:
 - A. Handle work of this section in accordance with AAMA Curtain Wall Manual #10.
 - B. Protect pre-finished aluminum surfaces with strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
- 1.7 PROJECT CONDITIONS:
 - A. Field Measurements: Verify actual dimensions of aluminum-framed storefront openings by field measurements before fabrication and indicate field measurements on Shop Drawings.
- 1.8 WARRANTY:
 - A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.
 1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS:
 - A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.
 - 1. Kawneer North America: www.kawneer.com.
 - B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed. Submit as substitution according to Conditions of the Contract and Division 1 Sections.
 - 1. United States Aluminum Corp: www.usalum.com.
 - 2. Arcadia.
 - 3. US Aluminum.
 - C. Substitutions: Refer to Section 01630 Product Substitutions.
- 2.2 ENTRANCE DOORS:

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- A. Basis-of-Design Product:
 - 1. Kawneer Company Inc.
 - 2. The door stile and rail face dimensions of the 500 entrance door will be as follows:

Door	Vertical Stile	Top Rail	Bottom Rail	Optional Bottom Rail
500	5" (127 mm)	5" (127 mm)	6-1/2" (166 mm)	10" (254 mm)

- 3. Major portions of the door members to be 0.125" (3.2) nominal in thickness and glazing molding to be 0.05" (1.3) thick.
- B. Extruded aluminum 6063-T5 alloy and temper (ASTM B221) with concealed reinforcement at corners.
- C. Glass and Glazing: As specified in Section 08800 Glazing.
- D. Hardware: As specified in Section 08710 Door Hardware.

2.3 STANDARD STOREFRONT FRAMES:

- A. Basis of Design Storefront Systems include:
 - 1. Trifab[™] VG 450 (2" Sightline) Framing System 2" x 4-1/2" (50.8 mm x 114.3 mm) nominal dimension; Non-Thermal; Front Plane, Structural Silicone or Weatherseal Glazed, Stick Fabrication.
 - 2. Extruded aluminum 6063-T6 alloy and temper (ASTM B221).
 - 3. Framing Size:
- B. System shall be designed for ¹/₄ inch thick glazing.
- C. Glass and Glazing: As shown on drawings and as specified in Section 08800 Glazing.
- D. Anchors: Manufacturer's standard aluminum or stainless steel, appropriate for the substrate involved.
- E. Flashing: Aluminum of configuration shown on drawings and finished to match frames.

2.4 SEALANT MATERIALS:

A. Sealant and Backing Materials: As specified in Section 07900.

2.5 FABRICATION:

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Arrange fasteners and attachments to conceal from view.
- E. Prepare components with internal reinforcement for door hardware.
- F. Reinforce framing members for imposed loads as indicated on approved shop drawings.
- 2.6 FINISHES:

ALUMINUM ENTRANCES AND STOREFRONTS

- A. Surface to be finished shall be free from mechanical imperfections such as scratches, scrapes, dents and die marks.
- B. Concealed members may be mill finish, providing that they cannot be seen through the glass, do not contact any structural silicone or are not continually exposed to water immersion.
- C. Finish: To be determined by Architect from entire Manufacturer's product selection.
- D. Conforming to AA-M12C22A31 and AAMA 607.1.
- E. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Acid-cromate-flouride-phosphate conversion coating; Organic Coating: As specified below). Prepare, pretreat and apply coating to exposed metal surfaces to comply with coating and resin Manufacturers' written instructions.
 - 1. Fluoropolymer Two-Coat Coating System: Manufacturer's standard two-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70% polyvinylidene fluoride resin by weight; comply with AAMA 2604.
 - 2. Resin Manufacturers: Subject to compliance with requirements, provide products containing resin by one of the following:
 - a. Kynar 500, Elf Atochem North America, Inc.
 - b. Duranar 500XL, PPG
 - c. Hylar 5000, Ausimont USA, Inc.
 - 3. Color and Gloss: As selected by Architect from Manufacturer's full range of choices for color and gloss.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.

3.2 INSTALLATION:

- A. Install systems in accordance with manufacturer's instructions and AAMA Metal Curtain Wall, Window, Store Front and Entrance Guide Specifications Manual.
- B. Attach to structure to permit adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances and alignment with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- G. Install hardware in accordance with manufacturer's instructions using templates provided.

ALUMINUM ENTRANCES AND STOREFRONTS

- H. Install glazing in accordance with Section 08800.
- I. Install perimeter sealant in accordance with Section 07900.

3.3 TOLERANCES:

- A. Maximum Variation from Plumb: 1/16 inches per 10 ft.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/16 inch.
- C. Maximum Diagonal Distortion at Doors: 1/16 inch measured with straight edge, corner to corner.

3.4 ADJUSTING:

A. Adjust operating hardware for smooth operation.

3.5 CLEANING:

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Clean glass immediately after installation. Comply with glass manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- 3.6 PROTECTION OF FINISHED WORK:
 - A. Protect finished Work from damage with padding or rigid board.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Mechanical and electrified door hardware for:
 1. Swinging doors.
 - B. Electronic access control system components, including:
 - 1. Electronic access control locksets and electric strikes.
 - 2. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
 - C. 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
 - D. Products furnished, but not installed, under this Section include the products listed below. Coordinating and scheduling the purchase and delivery of these products remain requirements of this Section.
 - 1. Lock cylinders to be installed under other Sections.
 - 2. Permanent lock cores to be installed by Owner.
- 1.2 RELATED SECTIONS:
 - A. Section 07900 Joint Sealants: for sealant requirements applicable to threshold installation specified in this section.
 - B. Section 08211 Flush Wood Doors.
 - C. Section 09900 Painting and Coatings: for touchup finishing or refinishing of existing openings modified by this section.
 - D. Division 16 sections for connections to electrical power system and for low-voltage wiring.
 - E. Division 16 sections for coordination with other components of electronic access control system.

1.3 REFERENCES0:

- A. NFPA 70 National Electric Code.
- B. NFPA 80 Standard for Fire Doors and Fire Windows.
- C. NFPA 101 Life Safety Code.
- D. NFPA 105 Smoke and Draft Control Door Assemblies.
- E. ICC/IBC International Building Code, 2012 Edition.

- F. State Building Codes, Local Amendments.
- G. State Fire Safety Code.
- H. UL 10B Fire Test of Door Assemblies.
- I. UL 10C Positive Pressure Test of Fire Door Assemblies.
- J. UL 1784 Air Leakage Tests of Door Assemblies.
- K. UL 305 Panic Hardware.
- L. ADA Americans with Disabilities Act.
- M. ANSI A117.1 Accessible and Usable Buildings and Facilities.
- N. DHI Door and Hardware Institute.
 - 1. Sequence and Format for the Hardware Schedule.
 - 2. Recommended Locations for Builders Hardware.
 - 3. Key Systems and Nomenclature.
- O. ANSI/BHMA A156.1 A156.29, and ANSI A156.31 Standards for Hardware and Specialties.

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. General:
 - 1. Submit in accordance with Conditions of Contract and Division 01 requirements.
 - 2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
 - 3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.
- C. 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.
- D. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - 1. Wiring Diagrams: For power, signal, and control wiring and including:
 - a. Details of interface of electrified door hardware and building safety and security systems.
 - b. Schematic diagram of systems that interface with electrified door hardware.
 - c. Point-to-point wiring.
 - d. Risers.
- E. 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.

- F. 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:
 - 1. Door Index; include door number, heading number, and Architects hardware set number.
 - 2. Opening Lock Function Spreadsheet: List locking device and function for each opening.
 - 3. Type, style, function, size, and finish of each hardware item.
 - 4. Name and manufacturer of each item.
 - 5. Fastenings and other pertinent information.
 - 6. Location of each hardware set cross-referenced to indications on Drawings.
 - 7. Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 8. Mounting locations for hardware.
 - 9. Door and frame sizes and materials.
 - 10. Name and phone number for local manufacturer's representative for each product.
 - 11. 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.
 - 12. 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.
- G. Key Schedule:
 - 1. 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.
 - 2. Use ANSI A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - 3. 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.
 - 4. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - 5. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
 - 6. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - 7. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
- H. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.
- I. Shop Drawings: Details of electrified access control hardware indicating the following:
 - 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - 2. Electrical Coordination: Coordinate with related Division 16 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware

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openings.

- J. Informational Submittals:
 - 1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
 - 2. Product Certificates for electrified door hardware, signed by manufacturer:
 - a. Certify that door hardware approved for use on types and sizes of labeled firerated doors complies with listed fire-rated door assemblies.
 - 3. Certificates of Compliance:
 - a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
 - b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
 - c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
 - 4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
 - 5. Warranty: Special warranty specified in this Section.
- K. 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. Parts list for each product.
 - e. Final approved hardware schedule, edited to reflect conditions as-installed.
 - f. Final keying schedule
 - g. Copies of floor plans with keying nomenclature
 - h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
 - i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.5 QUALITY ASSURANCE:

- A. Product Substitutions: Comply with product requirements stated in Section 01630 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 substitute" or "acceptable manufacturer", 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 and that provides certified Architectural

Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

- 1. Warehousing Facilities: In Project's vicinity.
- 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- 4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
 - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
- C. Manufacturers Qualifications: Engage qualified manufacturers with a minimum ten (10) years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- D. Installer Qualifications: Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum five (5) years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- E. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - 1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
 - 2. Can provide installation and technical data to Architect and other related subcontractors.
 - 3. Can inspect and verify components are in working order upon completion of installation.
 - 4. Capable of producing wiring diagrams.
 - 5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.
- F. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
 - 2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- G. 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.
- H. 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.
- I. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

- J. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.
- K. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:
 - 1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:
 - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
 - b. Door Closers: Comply with the following maximum opening-force requirements indicated:
 - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
 - 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
 - 3. NFPA 101: Comply with the following for means of egress doors:
 - a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
 - b. Thresholds: Not more than 1/2 inch high.
 - 4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.
 - a. Test Pressure: Positive pressure labeling.
- L. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf (22.2 N).
 - 2. Maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 - 4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.

1.6 ADMINISTRATIVE REQUIREMENTS:

- A. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.
 - 1. Attendees: Owner, Contractor, Architect, Installer, and Supplier's Architectural Hardware Consultant.
 - 2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:

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- a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
- b. Preliminary key system schematic diagram.
- c. Requirements for key control system.
- d. Requirements for access control.
- e. Address for delivery of keys.
- B. Pre-installation Conference: Conduct conference at Project site
 - 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.
- C. Coordination Conferences:
 - 1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
 - a. Attendees: Door hardware supplier, door hardware installer, Contractor.
 - b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.
 - 2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
 - a. Attendees: Owner's access control company Vegas Valley Locking Systems, electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner, Architect and Contractor.
 - b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

1.7 COORDINATION:

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical Requirements: Coordinate all electrical requirements for doors and frames. Make provisions for installation of electrical items so that wiring can be readily removed and replaced.
 - 1. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
 - 2. Provide cutouts and reinforcements required for metal door frame to accept electric components.
 - 3. Frame with Electrical Hinges: Weld UL listed grout guard cover box welded over center hinge reinforcing. Top or bottom hinge locations are not permitted.
 - 4. Provide cutouts and reinforcements required to accept security system components.
 - 5. Coordinate with Section 08710 for electrified hardware items.
- E. Existing Openings: Where hardware components are scheduled for application to existing

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construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

F. Direct shipments not permitted, unless approved by Contractor.

1.8 DELIVERY, STORAGE, AND HANDLING:

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
 - 1. Deliver each article of hardware in manufacturer's original packaging.
- C. Project Conditions:
 - 1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
 - 2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- D. Protection and Damage:
 - 1. Promptly replace products damaged during shipping.
 - 2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
 - 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- F. Deliver keys and permanent cores to: JJ Hall, Lead Locksmith, UNLV Lock Shop by registered mail or overnight package service.

1.9 MAINTENANCE:

- A. Extra Materials:
 - 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Door Hardware: Coordinate with UNLV Lock Shop
 - b. Electrical Parts: Coordinate with UNLV Lock Shop
- B. Maintenance Tools:
 - 1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- C. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- D. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

1.10 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.
 - Warranty Period: Years from date of Substantial Completion, for durations indicated.
 a. Closers:
 - 1) Mechanical: 30 years for LCN 4000
 - 2) Electrified: 2 years.
 - b. Automatic Operators: 1 year
 - c. Exit Devices:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 - d. Locksets:
 - 1) Mechanical: 7 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. The Owner requires use of certain products for their unique characteristics and particular project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
 - 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of manufacturers other than those listed shall be in accordance with QUALITY ASSURANCE article, herein.
- C. Approval of products from manufacturers indicated as "Acceptable Manufacturer" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

Item	Scheduled Manufacturer	Acceptable
		Manufacturer
Hinges	Ives (IVE)	Hager, Stanley
Continuous Hinges	Ives (IVE)	Markar, Stanley
Electric Power Transfer	Von Duprin (VON)	ABH,
Flush Bolt	Ives (IVE)	Hager, Rockwood
Surface Bolts	Ives (IVE)	Hager, Rockwood
Coordinators	Ives (IVE)	Hager, Rockwood
Locksets & Deadlocks	Schlage (SCH)	No Substitute
Aluminum Door Locks –	Medeco Keymark (MED)	No Substitute
Narrow Style		
Sliding Door Locks	Adams Rite (ADA)	As pre-approved
Pocket Door Locks	Accurate (ACC)	As pre-approved
Exit Devices & Mullions	Von Duprin (VON)	No Substitute
Electronic Access Control	Millennium	No Substitute
- Hardwired		
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Access Control Readers	Schlage Electronics (SCE)	No Substitute
Access Control Credentials	Schlage – Electronic (SCE)	No Substitute
Electric Strikes	Schlage – Electronic (SCE)	HES
Magnetic Locks - Surface	HES (HES)	No Substitute
Туре		
Magnetic Locks - Shear	Schlage Electronics (SCE)	Securitron
Туре		
Cylinders & Keying	Medeco Keymark (MED)	No Substitute
Door Closers	LCN (LCN)	No Substitute
Closer/Holder Unit	LCN (LCN)	No Substitute,
Electro-Mechanical	Stanley (STN)	LCN Sr. Swing
Automatic Operators		
Protection Plates	lves (IVE)	Hager, Rockwood
Overhead Stops	lves (IVE)	Hager, Rockwood
Thresholds & Weatherstrip	Ives (IVE)	Pemko, Zero
Silencers	Ives (IVE)	Pemko, Zero
Magnetic Holders	LCN (LCN)	Hager, Rockwood
Latch Protector	Ives (IVE)	Hager, Rockwood
Sliding Door Hardware	Ives (IVE)	Hager, Rockwood
Siluing Door Hardware		Hayer, NOCKWOOU

- 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 EXISTING MATERIALS

- A. Where existing door hardware is indicated to be removed and reinstalled:
 - 1. Carefully remove door hardware and components.
 - 2. Clean, protect and store existing door hardware in accordance with storage and handling requirements specified herein.
 - 3. Reinstall in accordance with installation requirements for new door hardware.

2.3 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: 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.

- 1. Use materials which match materials of adjacent modified areas.
- 2. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.
- C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
 - 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.
- D. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:
 - 1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
 - 2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
 - 3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.

2.4 HINGES

- A. Provide five-knuckle, ball bearing hinges.
 - 1. Manufacturers and Products:
 - a. Scheduled Manufacturer and Product: Ives 5BB series.
 - b. Acceptable Manufacturers and Products: Hager BB series, Stanley FBB series, Stanley FBB Series.
- B. Requirements:

1.

- ^{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
- 2. 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
- 3. 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
- 4. 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.
- 5. 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.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
- 7. 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.
- 8. 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.
- 9. 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.
- 10. Provide mortar guard for each electrified hinge specified, unless specified in hollow metal frame specification.
- 11. 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.

2.5 CONTINUOUS HINGES

- A. Stainless Steel
 - 1. Manufacturers:
 - a. Scheduled Manufacturer: Ives
 - b. Acceptable Manufacturers: Markar, Stanley
 - 2. Requirements:
 - a. Provide pin and barrel continuous hinges conforming to ANSI A156.26, Grade 2.
 - b. Provide pin and barrel continuous hinges fabricated from 14 gauge, type 304 stainless steel.
 - c. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25inch (6 mm) diameter stainless steel pin.
 - d. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
 - e. On fire-rated doors, provide pin and barrel continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
 - f. Provide pin and barrel continuous hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
 - g. Install hinges with fasteners supplied by manufacturer.
 - h. Provide hinges with symmetrical hole pattern.
- B. Cold-Rolled Steel
 - 1. Manufacturers:
 - a. Scheduled Manufacturer: lves
 - b. Acceptable Manufacturers: Markar, Stanley
 - 2. Requirements:
 - a. Provide pin and barrel continuous hinges conforming to ANSI A156.26, Grade 2.
 - b. Provide pin and barrel continuous hinges fabricated from type 1012 cold rolled steel.
 - c. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25inch (6 mm) diameter stainless steel pin.
 - d. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
 - e. On fire-rated doors, provide pin and barrel continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
 - f. Provide pin and barrel continuous hinges with electrified options as scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
 - g. Install hinges with fasteners supplied by manufacturer.
 - h. Provide hinges with symmetrical hole pattern.
- C. Aluminum Geared

1

- Manufacturers:
 - a. Scheduled Manufacturer: lves.
 - b. Acceptable Manufacturers: Markar, Stanley.
- 2. Requirements:
 - a. Provide aluminum geared continuous hinges conforming to ANSI A156.25, Grade 2.

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- b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum, with 0.25-inch (6 mm) diameter Teflon coated stainless steel hinge pin.
- c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, selflubricating operation.
- d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
- e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
- f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
- g. Install hinges with fasteners supplied by manufacturer.
- h. Provide hinges with symmetrical hole pattern.

2.6 ELECTRIC POWER TRANSFER

- A. Manufacturers:
 - 1. Scheduled Manufacturer: Von Duprin
 - 2. Acceptable Manufacturers: ABH
- 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.

2.7 FLUSH BOLTS

- A. Manufacturers:
 - 1. Scheduled Manufacturer: lves
 - 2. Acceptable Manufacturers: Hager, Rockwood
- 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.

2.8 SURFACE BOLTS

- A. Manufacturers:
 - 1. Scheduled Manufacturer: Ives
 - 2. Acceptable Manufacturers: Hager, Rockwood
- B. Requirements:
 - 1. Surface bolt s to have 1" throw for maximum security with concealed mounting that prevents vandalism. Units to be constructed of heavy duty steel and cUL listed up to three (3) hours when used on the inactive door of a pair up to 8' in height.

2.9 COORDINATORS

A. Manufacturers:

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- 1. Scheduled Manufacturer: Ives
- 2. Acceptable Manufacturers: Hager, Rockwood
- 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.

2.10 ALUMINUM DOOR LOCKS - WIDE STYLE

A. Manufacturer and Product: Adams Rite 4900 series X 4568/9 Lever or 4590/1 Paddle

B. Requirements:

- 1. Provide narrow style aluminum door locks as specified. Cylinders: Refer to "KEYING" article, herein.
- 2. Provide locks with [1-1/8 inches (29 mm)][1-1/2 inches (38 mm)] backset as required for door detail with full 5/8 inch (16 mm) throw latchbolt.
- 3. Provide manufacturer's standard strikes unless extended lip strikes are necessary to protect trim.

2.11 CYLINDRICAL LOCKS – GRADE 1

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product: Schlage ND Series
- B. Requirements:
 - 1. Provide cylindrical locks conforming to ANSI A156.2 Series 4000, Grade 1. Cylinders: Refer to "KEYING" article, herein.
 - 2. If Required- Provide cylindrical locks with classroom security function with an inside indicator that provides clear direction for users to safely and quickly secure the room.
 - 3. Provide locksets able to withstand 1500 inch pounds of torque applied to locked outside lever without gaining access per ANSI A156.2 Abusive Locked Lever Torque Test and cycle tested to 3 million cycles per ANSI A156.2 Cycle Test.
 - 4. Provide solid steel rotational stops to control excessive rotation of lever.
 - 5. Provide completely re-functionable lockset that allows lock function to be changed to over twenty other common functions by swapping easily accessible parts.
 - 6. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
 - 7. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
 - 8. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
 - 9. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
 - 10. Provide electrified options as scheduled in the hardware sets.
 - 11. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
 - a. Lever Design: Schlage Rhodes.
 - b. Tactile Warning (Knurling): Where required by authority having jurisdiction.
 - Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.
- 2.12 EXIT DEVICES OPTION: When requested to specify Von Duprin and/or the concealed cable device No Substitute.
 - A. Manufacturer and Product: Von Duprin 99/33 series OPTION 98/35 series, No Substitute

- B. Requirements:
 - 1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, [OPTION for specific compliant products/applications: UL certified to meet maximum 5 pound requirements according to the California Building Code section 11B-309.4,] 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. Quiet Operation: Incorporate fluid damper or other device that eliminates noise of exit device operation.
 - 4. Touchpad: Extend minimum of one half of door width, but not the full length of exit device rail. Provide end-cap with two-point attachment to door. 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. Provide compression springs in devices, latches, and outside trims or controls; tension springs prohibited.
 - 5. Provide rim devices with a dual cylinder or inside thumb turn cylinder option with a visual security indicator that identifies the trims locked/unlocked status of the door from the inside of the room. Indicator in unlocked state presents a 1/2 inch x 1/2 inch white metal flag with black icon at top of device head. Indicator in locked state has no flag present. Provide rim devices without the dual cylinder or inside thumb turn cylinder option capable of being retrofitted with the visual security indicator.
 - 6. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrical requirements.
 - 7. XP 98/99 only: Static Load Resistance, Rim Exit Devices: 2000+ lbs.
 - 8. XP 98/99 only: Latchbolt, Rim Exit Devices: Non-tapered smart latchbolt with 90° latchbolt to strike engagement under stress.
 - 9. 98/9949 and/or 33/3549A only: Concealed Vertical Cable Exit Devices: Cable-actuated concealed vertical latch system in two-point and less bottom latch (LBL) configurations. Vertical rods not permitted.
 - a. Cable: Stainless steel core wire in stainless steel with polytetrafluoroethylene (Teflon®) liner color-coded to latches and center slides. Conduit and core wire ends snap into latch and center slides without use of tools.
 - b. Latchbolts and Blocking Cams: Manufactured from sintered metal low carbon copper- infiltrated steel, with molybdenum disulfide low friction coating.
 - c. Top Latchbolt: Minimum 0.382 inch (10 mm) and greater than 90 degree engagement with strike to prevent door and frame separation under high static load.
 - d. Bottom Latchbolt: Minimum of 0.44 inch (11 mm) engagement with strike.
 - e. Product Cycle Life: 1,000,000 cycles.
 - f. Latch Operation: Top and bottom latch operate independently of each other. Top latch fully engages top strike even when bottom latch is compromised. Separate trigger mechanisms not permitted.
 - g. Latch release does not require separate trigger mechanism.
 - h. Cable and latching system characteristics:
 - 1) Assembled prior to being installed in door.
 - 2) Installed in door as complete assembly.
 - 3) Installed independently of exit device installation, and capable of functioning on door prior to device and trim installation.
 - 4) Connected to exit device at single attachment point.
 - 5) Bottom latch height adjusted from single point, after system is installed and connected to exit device, while door is hanging
 - 6) Latch position altered up and down 2 inches (51 mm) without additional adjustment.
 - 7) System may be removed while door is hanging.
 - 8) Configure latchbolt mounting: double or single tab mount for steel doors, and wood doors, face mount for aluminum doors, eliminating requirement of tabs.

- 9) Provide adjustable exit device to latch center line adjustment. Ensures double tab mounting option for top latch, regardless of exit device centerline.
- 10. Provide exit devices with manufacturer's approved strikes.
- 11. Provide exit devices cut to door width and height. Locate exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
- 12. 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.
- 13. Provide hex-key dogging at non-fire-rated exit devices, unless specified less dogging.
- 14. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion that is removed by use of a keyed cylinder, which is self-locking when re-installed.
- 15. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
 - a. Lever Style: Match lever style of locksets.
 - b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.
- 16. Provide UL labeled fire exit hardware for fire rated openings.
- 17. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
- 18. Provide electrified options as scheduled in the hardware sets.

2.13 ACCESS CONTROL READER

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product: aptiQ MT15. No substitute.
- B. Requirements: Read Only Multi-technology Contactless reader
 - 1. Access control card readers shall be as manufactured by a global company who is a recognized leader in the production of access control devices. Card reader manufactured for non-access control applications shall not be acceptable.
 - 2. Multi-technology contactless reader shall read access control data from both 125 kHz and 13.56 MHz contactless smart cards and NFC-compatible. The multi-technology 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 by providing:
 - a. Configuration allows reader to be enabled to read smart, proximity or both technologies at the same time.
 - b. A migration platform to upgrade from the most popular 125 kHz proximity technologies to MIFARE or MIFARE DESFire EV1 by reading both 125 kHz proximity technology and 13.56 MHz contactless smart card technology.
 - c. Guaranteed compatibility to read all standard data formats ensuring card-toreader interoperability in multi-location installations and multi-card/reader populations.
 - d. Secure access control data exchange between the smart card and the reader utilizing diversified keys and mutual authentication sequences.
 - e. Universal compatibility with most access control systems.
 - f. Ease of installation through industry standard wiring methods.
 - g. Compatibility with legacy 125 KHz proximity access control formats (all standard formats up to 37 bits, including HID Corporate 1000 formats).
 - standard formats up to 37 bits, including HID Corporate 1000 formats).
 - h. Optimal read range and read speed for increased access control throughput.
 - i. Global availability.

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- j. Product construction suitable for both indoor and outdoor applications.
- k. Customizable behavior for indicator lights and beeper.
- Multi-technology contactless reader shall comply with the following 13.56MHz-related standards to ensure product compatibility and predictability of performance:
 a. ISO 14443
- 4. Multi-technology contactless reader shall be configurable to read 13.56 MHz data simultaneously from the following cards (multiple credential support based on reader configuration):
 - a. Secure support Mifare DESFire EV1with PACSA, Mifare Classic, FIPS 201 PIV Credential.
 - b. UID/CSN Support DESFire Classic V0.06, HID iClass, ISOX (my-d).
 - c. Proximity Schlage Proximity, XID Proximity, HID Prox, AWID, GE/CASI, Lenel Prox, Inside Pictotag, TI Tagit, ST Micro.
- 5. Multi-technology contactless reader shall be configurable to read data from any compatible 125 kHz technology simultaneously with 13.56 MHz data. Compatible 125 kHz technologies include:
 - a. XCEEDID/Schlage/HID Prox (format in the card formats up to 37-bits supported).
 - b. AWID PROX (SAME AS LENEL PROX format in the card formats up to 42bits).
 - c. GE PROX two possible format options.
- 6. Multi-technology contactless reader shall provide the ability to read card access data stored in the secure access control sector/application area of the ISO 14443 XceedID MIFARE or MIFARE DESFire EV1 card.
- 7. The Multi-technology contactless reader shall be configurable to provide multiple hierarchical degrees of key compatibility for accessing the smart card access control data. Compatibility shall be provided for the following key structure options:
 - a. Compatibility with the default manufacture's key structure to ensure convenient off the shelf compatibility with manufacture's cards and readers.
 - b. Compatibility with custom keys managed by manufacturer which provide a sitespecific, unique, protected key structure.
 - c. Compatibility with high security customer managed custom keys.
- 8. The Multi-technology contactless reader shall be configurable to provide compatibility with all standard Prox formats up to 37 bits (including Corporate 1000[®]).
- 9. Multi-technology contactless reader shall allow the reader firmware to be upgraded in the field without the need to remove the reader from the wall through the use of factory-provided device.
- 10. Multi-technology contactless reader shall be suitable for global deployment by meeting worldwide radio and safety regulatory compliance including:
 - a. FCC Certification (US)
 - b. CE (EU)
 - c. C-tick (Australia, New Zealand)
 - d. R&TTÈ Directive (15EU)
 - e. UL294 (US)
 - f. ULC-S319
 - g. IC (Canada)
 - ň. FIPS201 / PIV I
 - i. IP65
- 11. Multi-technology contactless reader shall be fully compliant with Restriction of Hazardous Substances directive (RoHS) restricting the use of specific hazardous materials found in electrical and electronic products.
- 12. Multi-technology contactless reader shall provide universal compatibility with most access control systems by outputting card data in compliance with the SIA AC-01 Wiegand standard.
- 13. Multi-technology contactless reader shall allow for secure installation practices through mounting methods utilizing tamper resistant screws.

- 14. Multi-technology contactless reader shall provide the ability to transmit an alarm signal via and integrated optical tamper switch if an attempt is made to remove the reader from the wall. The tamper switch shall be programmable to provide a selectable action to provide a selectable action compatible with various tamper communication schemes provided by access control panel manufacturers. The selectable action shall include one of the following:
 - a. The reader open collector line changes from a high state (5V) to a low state (Ground).
 - If utilizing OSDP Protocol reader shall report a tamper condition via RS485.
- 15. Multi-technology contactless reader shall provide the ability for mounting to standard electrical boxes through the use of universal international mounting holes.
- 16. Multi-technology contactless reader shall be provided with a full potted assembly.
- 17. Multi-technology contactless reader shall be provided with a quick connect wire harness.
- 18. The Multi-technology contactless reader shall provide customizable reader behavior options either from the factory, or defined in the field through the use of pre-configured command cards. Reader behavior programming options shall include:
 - a. LED & Audio configurations.

b

- b. Ability to disable reading of specific card technologies or frequencies.
- c. ISO 14443/15693 CSN output configuration.
- d. Wiegand output spacing and timing.
- 19. Multi-technology contactless reader shall provide the following programmable audio/visual indication:
 - a. An audio beeper shall provide tone sequence to signify: access granted, access denied, power up, and diagnostics.
 - b. A light bar shall provide clear visual status (red/green/amber).
- 20. Multi-technology contactless reader shall be designed for low current operation to enable migration from most legacy proximity applications without the need to replace existing access control panels and/or power supplies. Contactless smart card power requirements shall be:
 - a. Operating voltage: 5 16 VDC, reverse voltage protected. Linear power supply recommended.
 - b. Current requirements: 160 mA DC, 195 mA PEAK @ 12 VDC
- 21. Multi-technology contactless reader shall meet the following physical specifications:
 - a. Dimensions: 5.1" x 3.25" x 0.83" (12.9 cm x 8.3 cm x 2.1 cm)
 - b. Weight: 9.6 oz. (272.15 g)
 - c. Material: UL94 Polycarbonate
 - d. Plastics: Consist of three-piece design with mounting plate, potted case and aesthetic cover.
 - e. Color: Black, Gray, Brown or Cream as approved by the project architect.
- 22. Multi-technology contactless reader shall meet the following environmental specifications:
 - a. Operating temperature: -31 to 151 degrees F (-35 to 67 degrees C)
 - b. Operating humidity: 5% to 95% relative humidity non-condensing
 - c. Weatherized design suitable to withstand harsh environments
 1) Certified rating of IP65
- 23. Multi-technology contactless reader cabling requirements shall be:
 - a. Cable distance: (Wiegand): 500 feet (150m)
 - b. Cable type: 5-conductor #22 AWG
 - c. Standard reader termination: 18" (0.5m) wire harness
- 2.14 ELECTRIC STRIKES
 - A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product: SCE

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- B. Requirements:
 - 1. Provide electric strikes designed for use with type of locks shown at each opening.
 - 2. Provide electric strikes UL Listed as burglary-resistant.
 - 3. Where required, provide electric strikes UL Listed for fire doors and frames.
 - 4. Provide fail-secure type electric strikes, unless specified otherwise.
 - 5. Coordinate voltage and provide transformers and rectifiers for each strike as required.

2.15 CYLINDERS

A. Manufacturers:

1.

- 1. Scheduled Manufacturer: Medeco KeyMark.
- 2. Coordinate keying requirements with JJ Hall, Locksmith Lead, UNLV Lock Shop.
- B. Small Format IC cylinders distributed throughout the Project as indicated.
 - Security: dual-locking cylinder with interchangeable core requiring restricted, patented keyway. Medeco KeymarkKeyway
- 2.16 CYLINDERS OPTION: for EXISTING key system
 - A. Manufacturer: Medeco
 - 1. Scheduled Manufacturer: Keymark, No Substitute
 - B. Requirements: Provide cylinders/cores complying with the following requirements.
 - 1. Cylinders/cores 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.
 - C. Manufacturer-keyed permanent cylinders/cores, configured into existing keying system per "KEYING" article herein. Must coordinate keying with JJ Hall, Locksmith Lead, UNLV Lock Shop.
 - D. Nickel silver bottom pins.1. Identification:
 - E. 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.
 - F. Identification stamping provisions must be approved by the Architect and Owner.
 - G. Failure to comply with stamping requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - 1. Forward cylinders/cores to Owner, separately from keys, by means as directed by Owner.
 - 2. Exterior Doors: Security cylinders with interchangeable cores requiring use of restricted, patented keys incorporating dual-locking mechanism with 5 interlocking pins to check for patented key features.
 - 3. Doors Designated as High Security: High security cylinders with permanent cores requiring use of restricted, patented keys incorporating dual-locking mechanism with 5 interlocking pins to check for patented key features; compliant with UL437 for drill and pick resistance; and integrated into exterior keying system without change to bitting combinations.
- 2.17 DOOR CLOSERS OPTION:

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- A. Manufacturer and Product: LCN 4040XP series. No Substitute
- B. Requirements:
 - 1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
 - 2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
 - 3. Cylinder Body: 1-1/2 inch (38 mm) diameter with 3/4 inch (19 mm) diameter double heat-treated pinion journal.
 - 4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
 - 5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
 - 6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
 - 7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
 - 8. Pressure Relief Valve (PRV) Technology: Not permitted.
 - 9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
 - 10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.18 ELECTRO-MECHANICAL AUTOMATIC OPERATORS:

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product: Stanley Magic Force Auto Operators
- B. Requirements:
 - 1. Provide low energy automatic operator units that are electro-mechanical design complying with ANSI A156.19.
 - a. Opening: Powered by DC motor working through reduction gears.
 - b. Closing: Spring force.
 - c. Manual, hydraulic, or chain drive closers: Not permitted.
 - d. Operation: Motor is off when door is in closing mode. Door can be manually operated with power on or off without damage to operator. Provide variable adjustments, including opening and closing speed adjustment.
 - e. Cover: Aluminum.
 - 2. Provide units with manual off/auto/hold-open switch, push and go function to activate power operator, vestibule interface delay, electric lock delay, hold-open delay adjustable from 2 to 30 seconds, and logic terminal to interface with accessories, mats, and sensors.
 - 3. Provide drop plates, brackets, or adapters for arms as required to suit details.
 - 4. Provide hard-wired motion sensors and/or actuator switches for operation as specified. Provide weather-resistant actuators at exterior applications.
 - 5. Provide key switches, with LED's, recommended and approved by manufacturer of automatic operator as required for function as described in operation description of hardware sets. Cylinders: Refer to "KEYING" article, herein.
 - 6. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence

operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.

7. Provide units with inputs for smoke evacuation doors, where specified, which allow doors to power open upon fire alarm activation and hold open indefinitely or until fire alarm is reset, presence detector input, which prevents closed door from opening or door that is fully opened from closing, hold open toggle input, which allows remote activation for indefinite hold open and close second time input is activated, vestibule inputs, which allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.19 DOOR TRIM:

- A. Manufacturers:
 - 1. Scheduled Manufacturer: lves.
 - 2. Acceptable Manufacturers: Hager, Rockwood.
- 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.

2.20 PROTECTION PLATES:

- A. Manufacturers:
 - 1. Scheduled Manufacturer: lves.
 - 2. Acceptable Manufacturers: Burns, Rockwood.
- B. Requirements:
 - 1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick 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

2.21 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS:

A. Manufacturers:

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- 1. Scheduled Manufacturers: Glynn-Johnson
- 2. Acceptable Manufacturers: Hager, Rockwood
- 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.

2.22 DOOR STOPS AND HOLDERS:

- A. Manufacturers:
 - 1. Scheduled Manufacturer: lves.
 - 2. Acceptable Manufacturers: Hager, Rockwood.
- B. Provide door stops at each door leaf:
 - 1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
 - 2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
 - 3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.23 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING:

- A. Manufacturers:
 - 1. Scheduled Manufacturer: National Guard Products.
 - 2. Acceptable Manufacturers: Pemko, Zero.
- B. Requirements:
 - 1. Provide thresholds, weatherstripping (including door sweeps, seals, 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.

2.24 SILENCERS:

- A. Manufacturers:
 - 1. Scheduled Manufacturer: Ives.
 - 2. Acceptable Manufacturers: Hager, Rockwood.
- B. Requirements:
 - 1. Provide "push-in" type silencers for hollow metal or wood frames.
 - 2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two

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for each pair frame.

3. Omit where gasketing is specified.

2.25 MAGNETIC HOLDERS:

- A. Manufacturers:
 - 1. Scheduled Manufacturer: LCN.
 - 2. Acceptable Manufacturers: Rixson, Sargent.
- B. Requirements:
 - 1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordination projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Wire magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.
- 2.26 LATCH PROTECTORS:
 - A. Manufacturers:
 - 1. Scheduled Manufacturer: lves.
 - 2. Acceptable Manufacturers: Hager, Rockwood.
 - B. Provide latch protectors of type required to function with specified lock.

2.27 FINSHES:

- A. Finish: BHMA 626/652 (US26D); except:
 - 1. Hinges at Exterior Doors: BHMA 630 (US32D)
 - 2. Continuous Hinges: BHMA 630 (US32D)
 - 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. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

- A. Where on-site modification of doors and frames is required:
 - 1. Remove existing hardware being replaced, tag, and store according to contract documents.
 - 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 in accordance with:
 - a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
 - b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
 - c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.3 INSTALLATION:

- A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- H. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
- I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as indicated in keying section.
- J. Lead Protection: Lead wrap hardware penetrating lead-lined doors. Levers and roses to be lead lined. Apply kick and armor plates on lead-lined doors with adhesive as recommended by manufacturer.

- K. 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.
- L. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- M. 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.
- N. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. 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. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
- P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- Q. 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.
- R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL:

- A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING:

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 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.

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B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant 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.

3.6 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.

3.7 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."

3.8 DOOR HARDWARE SCHEDULE:

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- B. See door schedule in drawings for hardware set assignments.
- C. Manufacturers and their abbreviations used in this schedule:
- 3.9 DOOR HARDWARE SCHEDULE:

<u>HW SET 01</u>

For use on mark/door #(s): 304

Qty		Description	Catalog Number	Finish	Mfr
4	EA	HINGÉ	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 03B	626	SCH
1	EA	SFIC PERM CORE	RESTRICTED - CONFIRM W/ OWNER		
1	EA	ELECTRIC STRIKE	1006 SERIES	630	HES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	MULTITECH READER	MT15	BLK	SCE

POWER SUPPLY, ELECTRIC STRIKE, CARD READER, DPS SWITCH, AND WIRING, BY OWNER SUPPLIED SECURITY CONTRACTOR

<u>HW SET 02</u>

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For use on mark/door #(s): 310A 310B 312B 325C 312A 316C 325D 332 340 342 Qty Description Catalog Number Finish Mfr ΕA HINGE 5BB1 4.5 X 4.5 652 IVE 3 626 1 EΑ STOREROOM LOCK L9080BDC 03B SCH 1 ΕA SFIC PERM CORE **RESTRICTED - CONFIRM W/ OWNER** 1 EΑ ELECTRIC STRIKE 1006 SERIES 630 HES 4040XP REG OR PA AS REQ 689 1 EA SURFACE CLOSER LCN 1 ΕA KICK PLATE 8400 10" X 2" LDW B4E 630 IVE EΑ WALL STOP WS406/407CCV 630 IVE 1 3 EΑ SILENCER **SR64** GRY IVE EΑ MULTITECH READER BLK SCE 1 MT15

POWER SUPPLY, ELECTRIC STRIKE, CARD READER, DPS SWITCH, AND WIRING, BY OWNER SUPPLIED SECURITY CONTRACTOR

HW SET 03 - 5" NET POCKET NECESSARY FOR INSTALLATION OF THE L9080 MORTISE LOCK

For use on mark/door #(s): 321G

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 03B	626	SCH
1	EA	SFIC PERM CORE	RESTRICTED - CONFIRM W/ OWNER		
1	EA	ELECTRIC STRIKE	1006 SERIES	630	HES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	PA MOUNTING PLATE	4040-18PA-as required	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	MULTITECH READER	MT15	BLK	SCE

Head, jamb, and meeting-stile seals: integral part of alum/glass frame and door system.

POWER SUPPLY, ELECTRIC STRIKE, CARD READER, DPS SWITCH, AND WIRING, BY OWNER SUPPLIED SECURITY CONTRACTOR

<u>HW SET 04</u>

For use on mark/door #(s): 205A

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	REMOVABLE MULLION	4954XP	SP28	VON
1	EA	PANIC HARDWARE	XP-98-EO	626	VON
1	EA	PANIC HARDWARE	XP-98-L-03	626	VON
1	EA	SFIC RIM CYLINDER	80-116	626	SCH
1	EA	SFIC PERM CORE	RESTRICTED - CONFIRM W/ OWNER		
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
2	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
2	EA	WALL STOP	WS406/407CCV	630	IVE

2	EA	SILENCER
1	EA	MULTITECH READER

SR64	GRY	IVE
MT15	BLK	SCE
BALANCE OF HARDWARE BY DOOR		
MANUFACTURER		

MULLION TO BE PREPPED FOR PANIC STRIKE & ELECTRIC STRIKE. POWER SUPPLY, ELEC STRIKE, CARD READER, DPS SWITCH, AND WIRING, BY OWNER SUPPLIED SECURITY CONTRACTOR

HW SET 05

For use on mark/door #(s):

321A		321B	323A	323B	325B		
Qty		Description		Catalog Number		Finish	Mfr
3	EA	HINGÉ		5BB1 4.5 X 4.5		652	IVE
1	EA	PANIC HARDWARE	Ē	XP-98-L-03		626	VON
1	EA	SFIC RIM CYLINDE	R	80-116		626	SCH
1	EA	SFIC PERM CORE		RESTRICTED - CONF	IRM W/ OWNER		
1	EA	ELECTRIC STRIKE		6300 FSE		630	VON
1	EA	SURFACE CLOSEF	2	4040XP REG OR PA	AS REQ	689	LCN
1	EA	KICK PLATE		8400 10" X 2" LDW B4	ŀΕ	630	IVE
1	EA	WALL STOP		WS406/407CCV		630	IVE
3	EA	SILENCER		SR64		GRY	IVE
1	EA	MULTITECH READ	ER	MT15		BLK	SCE

POWER SUPPLY, ELECTRIC STRIKE, CARD READER, DPS SWITCH, AND WIRING, BY OWNER SUPPLIED SECURITY CONTRACTOR

HW SET 06

For use on mark/door #(s): 325A

Qty		Description	Catalog Number	Finish	Mfr
4	EA	HINGE	5BB1 5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	XP-98-L-03	626	VON
1	EA	SFIC RIM CYLINDER	80-116	626	SCH
1	EA	SFIC PERM CORE	RESTRICTED - CONFIRM W/ OWNER		
1	EA	ELECTRIC STRIKE	6300 FSE	630	VON
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	MULTITECH READER	MT15	BLK	SCE

POWER SUPPLY, ELECTRIC STRIKE, CARD READER, DPS SWITCH, AND WIRING, BY OWNER SUPPLIED SECURITY CONTRACTOR

HW SET 07

For use on mark/	door #(s):			
321C	321D	321E	321F	321H

Qty	Description	Catalog Number	Finish	Mfr

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DOOR HARDWARE

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1	EA	CONT. HINGE	112HD	628	IVE
1	SET	PUSH/PULL BAR	9190HD-10"-NO	630	IVE
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	MOUNTING PLATE	4040-18 -as required	689	LCN
1	EA	WALL STOP	WS406/407CCV	630	IVE

- Head, jamb, and meeting-stile seals: integral part of alum/glass frame and door system.

<u>HW SET 08</u>

For use on mark/door #(s):

338

336

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8302 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	MOP PLATE	8400 4" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

<u>HW SET 09</u>

For use on mark/door #(s): 334

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGÉ	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 03B	626	SCH
1	EA	SFIC PERM CORE	RESTRICTED - CONFIRM W/ OWNER		
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

<u>HW SET 10</u>

For us	se on r	mark/door #(s):					
302		316A	316B	318	320A	324B	
Qty 1 1	EA EA	Description ELECTRIC STF MULTITECH R	RIKE EADER	Catalog Number 1006 SERIES MT15 RE-USE BALANCE HARDWARE	OF DOOR, FRAM	Finish 630 BLK E &	Mfr HES SCE

POWER SUPPLY, ELECTRIC STRIKE, CARD READER, DPS SWITCH, AND WIRING, BY OWNER SUPPLIED SECURITY CONTRACTOR

END OF SECTION

SECTION 08800

GLAZING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Provide all Glass indicated on drawings or specified herein, including all labor, materials, equipment, and services necessary to complete the glass and glazing, including, but not limited to, the following:
 - 1. Glazing of the Aluminum Storefronts and Entrances.
 - 2. Glass and glazing for wood doors.
 - 3. Maintenance materials of glass and glazing materials.
 - 4. Attic stock of glass and glazing materials, if required

1.2 REFERENCES:

- A. International Building Code (IBC), 2012 Edition, with Local Amendments.
- B. AAMA CW-DG-1, Aluminum Curtain Wall Design Guide Manual.
- C. AAMA GAG-1, Glass and Glazing.
- D. AAMA CWS-12, Structural Properties of Glass.
- E. AAMA 807.1 Glazing Tapes.
- F. ASTM C1036 Standard Specification for Flat Glass; 2011e1.
- G. ASTM C1048 Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- H. ASTM E773 Test Method for Accelerated Weathering of Sealed Insulating Glass Units.
- I. ASTM E774 Specification for Classification of the Durability of Sealed Insulating Glass Units.
- J. FGMA, Flat Glass Marketing Association, Glazing Manual.
- K. SIGMA Sealed Insulated Glass Manufacturers Association.
- L. CPSC 16 CFR Part 1201, Safety Standard for Architectural Glazing Material.
- M. ANSI Z97.1, Performance Specifications and Methods of Test for Transparent Safety Glazing Material Used in Buildings; 2010.
- N. GANA Glass Associate of North America Latest Edition.
 - 1. GANA (GM) GANA Glazing Manual
 - 2. GANA (SM) FGMA Sealant Manual

1.3 RELATED SECTIONS:

A. Section 08110 – Hollow Metal Frames.

- B. Section 08211 - Flush Wood Doors.
- C. Section 08411 - Aluminum Framed Entrances and Storefront.
- D. Section 10801 - Toilet and Bath Accessories.

1.4 PERFORMANCE REQUIREMENTS:

- Α. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- Β. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the in service conditions.
- Thermal Movements: Provide glazing that allows for thermal movements resulting from the C. following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss. 1.
 - Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.5 SUBMITTALS:

- A. Refer to Section 01330 – Submittal Procedures, for submittal requirements.
- Β. Product Data: For each glass product and glazing material indicated provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements, rating requirements and special conditions applicable to fire and safety glazing ratings.
- C. Samples: For the following products, submit samples in the form of 12-inch- square glass.
 - Each color of tinted float glass. 1.
 - Coated vision glass. 2.
 - 3. Insulating glass for each designation indicated.
 - 4. Mirror glass.
 - 5. Spandrel panels.
- D. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE:

- Α. Perform Work in accordance with GANA Glazing Manual and GANA Sealant Manual for glazing installation methods.
- Β. Installer Qualifications: Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.
- C. Safety Glazing Products: Comply with testing requirements in CPSC 16 CFR 1201.
 - Where safety glazing units are specified for glazing lites more than 9 sq. ft. in exposed 1. surface area of one side, provide units that comply with Category II requirements
 - 2. For safety glazing lites 9 sq. ft. or less in exposed surface area of one side, provide glazing products that comply with Category II requirements.

- D. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- E. Submit manufacturer's certified identification, showing strength, grade, thickness, type and quality for each type of glass used. Mark tempered, heat strengthened and laminated glass with permanent identification labels.

1.7 PROJECT CONDITIONS:

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.8 WARRANTY:

A. Provide ten (10) year manufacturer's warranty under provisions of the front end and/or general conditions.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS/FABRICATORS:
 - A. Float Glass Manufacturers
 - 1. Guardian Industries Corp.
 - 2. Pilkington
 - 3. PPG
 - 4. Saint Gobain
 - 5. Visteon
 - B. Float Glass Fabricators Tempered, Non-Coated, Insulated
 - 1. ACI
 - 2. AFGD
 - 3. Hehr Glass
 - 4. Northwestern Industries
 - 5. Oldcastle Glass
 - C. Substitutions: See Section 01630 Product Substitutions.

2.2 FLAT GLASS MATERIALS

- A. Type 1: Clear Glass: ASTM C1036, Type 1, Class 1, Quality: q5-Glazing B.
- B. Type 2: FT Glass: Fully Tempered, ASTM C1048, FT, Type 1, Class 1 or 2, Quality: q5-Glazing B, CPSC 16 CFR Part 1201, Safety Standard for Architectural Glazing Materials.
- C. Type 3: HS Glass: Heat Strengthened, ASTM C1048, HS, Type 1, Class 1 or 2, Quality: q5-Glazing B.
- D. Type 4: Mirror Glass: Heat Strengthened, ASTM C1048, HT, Type 1, Class 1, q2-Mirror Quality with silver and copper plate backing and polished edges. Provide for direct adhesive mounting.
- E. Type 5: Laminated Glass: Meet requirements of ASTM C1172 Standard for Laminated Architectural Flat Glass

- 1. Glass: ASTM C1036, Type 1, Class 1, q5-Glazing B Quality.
- 2. Conform to CPSC 16 CFR Part 1201, Safety Standard for Architectural Glazing Materials.
- F. General Identification Requirements For Glass
 - 1. Identification. Each pane shall bear the manufacturer's mark designating the type and thickness of the glass or glazing material.
 - 2. The identification shall not be omitted unless approved and an affidavit is furnished by the glazing contractor certifying that each light is glazed in accordance with approved construction documents that comply with the provisions of IBC.
 - 3. Each pane of tempered glass, except tempered spandrel glass, shall be permanently identified by the manufacturer. The identification mark shall be acid etched, sand blasted, ceramic fired, laser etched, embossed or of a type that, once applied, cannot be removed without being destroyed.
 - 4. Tempered spandrel glass shall be provided with a removable paper marking by the manufacturer.
 - 5. Safety glazing shall be identified as specified elsewhere in this section.
 - 6. Bow and warp. Glass manufacturer shall provide a QC program to detect and discard any lites which exceed the following tolerances:
 - a. Glass that has any deviation from flat (bow) of 0.15% of the shortest glass dimension.
 - b. Where the heat treating process results in essentially parallel ripples or waves, the deviation from flatness at any peak shall not exceed 0.0051", and the difference between adjacent peaks shall not exceed 0.0031".
 - c. Where bow tolerance and wave tolerance differ, the stricter requirements shall govern.
 - d. Direction of ripples shall be horizontal, consistent and in conformance with the architectural design.

2.3 SAFETY GLAZING

- A. Individual glazed areas, including glass mirrors, in hazardous locations as defined in IBC shall comply with impact test requirements.
- B. Impact test. Where required by IBC glazing shall be tested in accordance with CPSC 16 CFR 1201. Glazing shall comply with the test criteria for Category I or II as listed in IBC.
- C. Identification of Safety Glazing.
 - 1. Each pane of safety glazing installed in hazardous locations shall be identified by a manufacturer's designation specifying who applied the designation, the manufacturer or installer and the safety glazing standard with which it complies, as well as the information specified for general glass.
 - 2. The designation shall be acid etched, sand blasted, ceramic fired, laser etched, embossed or of a type that once applied, cannot be removed without being destroyed.

2.4 GLASS TYPES:

- A. Glass Type 1: Single Pane: 1/4" clear glass
- B. Glass Type 2: Single Pane: 1/4" clear FT glass
- 2.5 GLAZING SEALANTS:
 - A. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified.
 - 1. Single-Component Neutral-Curing Silicone Glazing Sealants Type S, Class 50:

<u>GLAZING</u>

- a. Dow Corning Corporation; 790.
- b. GE Silicones; SilPruf LM SCS2700.
- c. Tremco; Spectrem 1 (Basic).
- d. GE Silicones; SilPruf SCS2000.
- e. Pecora Corporation; 864.
- f. Pecora Corporation; 890.
- g. Sonneborn, Div. of ChemRex, Inc.; Omniseal.
- h. Tremco; Spectrem 3.

2.6 GLAZING TAPES:

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and non-migrating in contact with nonporous surfaces; with or without spacer rod as recommended by tape and glass manufacturers and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.7 MISCELLANEOUS GLAZING MATERIALS:

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

- 3.1 EXAMINATION:
 - A. Examine framing glazing, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep system.
 - 3. Minimum required face or edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
 - B. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 PREPARATION:

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL:

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches as follows:
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING:

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

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- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY):

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET):

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION:

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction

operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

SECTION 08830

MIRRORS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Annealed monolithic glass mirrors.
- B. Tempered glass mirrors qualifying as safety glazing.

1.2 RELATED SECTIONS:

- A. Section 08800 Glazing: for glass with reflective coatings used for vision and spandrel lites.
- B. Section 10801 Toilet and Bath Accessories: for metal-framed mirrors.

1.3 REFERENCE STANDARDS

- A. ANSI Z97.1 American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test; 2010.
- B. ASTM C1036 Standard Specification for Flat Glass; 2011e1.
- C. ASTM C1193 Standard Guide for Use of Joint Sealants; 2013.
- D. ASTM C1503 Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).
- E. GANA (GM) GANA Glazing Manual; Glass Association of North America; 2009.
- F. GANA (SM) GANA Sealant Manual; Glass Association of North America; 2008.
- G. GANA (TIPS) Mirrors: Handle with Extreme Care (Tips for the Professional on the Care and Handling of Mirrors); Glass Association of North America; 2011.

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: For each type of product indicated.
 - 1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
- C. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.
- D. Samples: For each type of the following products:
 - 1. Mirrors: 12 inches (300 mm) square, including edge treatment on two adjoining edges.
 - 2. Mirror Clips: Full size.
 - 3. Mirror Trim: 12 inches (300 mm) long.

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- E. Qualification Data: For qualified Installer.
- F. Product Certificates: For each type of mirror and mirror mastic, from manufacturer.
- G. Preconstruction Test Reports: From mirror manufacturer indicating that mirror mastic was tested for compatibility and adhesion with mirror backing [**paint**] [**film**] and substrates on which mirrors are installed.
- H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- I. Maintenance Data: For mirrors to include in maintenance manuals.

1.5 QUALITY ASSURANCE:

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
- C. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.
- D. Glazing Publications: Comply with the following published recommendations:
 - 1. GANA's "Glazing Manual" unless more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined in this Section or in referenced standards.
 - 2. GANA Mirror Division's "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."
- E. Safety Glazing Products: For tempered mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.
- F. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing [**paint**] [**film**] and substrates on which mirrors are installed.
- 1.6 DELIVERY, STORAGE, AND HANDLING:
 - A. Do not install mirrors when ambient temperature is less than 50 degrees F.
 - B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.
 - C. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
 - D. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.7 PROJECT CONDITIONS:

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity

conditions are maintained at levels indicated for final occupancy.

1.8 WARRANTY:

- A. Special Warranty: Manufacturer's standard form in which mirror manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
 - 1. Warranty Period: Five (5) years from date of Substantial Completion

PART 2 - PRODUCTS

- 2.1 SILVERED FLAT GLASS MIRRORS:
 - A. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
 - 1. <u>Manufacturers</u>: 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. <u>Avalon Glass and Mirror Company</u>.
 - b. <u>D & W Incorporated</u>
 - c. <u>Guardian Industries</u>.
 - d. <u>Head West</u>.
 - e. Maran-Wurzell Glass & Mirror.
 - f. <u>National Glass Industries</u>.
 - B. Clear Glass: Mirror Select Quality; ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission.
 - 1. Nominal Thickness: ¹/₄" (6.0 mm).
 - C. Tempered Clear Glass: Mirror Glazing Quality, for blemish requirements; and comply with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied.
 1. Nominal Thickness: ¼" (6.0 mm).
- 2.2 MISCELLANEOUS MATERIALS:
 - A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
 - B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
 - C. Mirror Mastic: Polymer type mirror mastic resistant to water, shock, cracking, vibration and thermal expansion, compatible with mirror backing paint and approved by mirror manufacturer.
 - 1. Adhesive shall have a VOC content of not more than **70** g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 - D. Film Backing for Safety Mirrors: Apply a polypropylene splinter-free film backing and pressuresensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.3 MIRROR HARDWARE:

- A. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.
 1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/
 - Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch (9.5 and 22 mm) in height, respectively, and a thickness of not less than 0.05 inch (1.3 mm).
 - 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) Laurence, C. R. Co., Inc.; CRL Standard "J" Channel.
 - Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.062 inch (1.57 mm).
 - 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) Laurence, C. R. Co., Inc.; CRL Deep "J" Channel.
 - 2) Finish: Clear anodized.
- B. Top Channel/Cleat and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.
 - 1. Bottom Trim: J-channels formed with front leg and back leg not less than 5/16 and 3/4 inch (7.9 and 19 mm) in height, respectively.
 - a. Product: Subject to compliance with requirements, provide D638 FHA Type "J" <u>Channel by Laurence, C. R. Co., Inc</u>.
 - 2. Top Trim: Formed with front leg with a height of 5/16 inch (7.9 mm) and back leg designed to fit into the pocket created by wall-mounted aluminum cleat.
 - a. Product: Subject to compliance with requirements, provide D1638 Top
 - Channel and D1637M Mirror Mount System Cleat by Laurence, C. R. Co., Inc.
 - 3. Finish: **Clear** anodized.
- C. Mirror Bottom Clips: As indicated.
- D. Mirror Top Clips: As indicated.
- E. Plated Steel Hardware: Formed-steel shapes with plated finish indicated.
 - 1. Profile: As indicated.
 - 2. Finish:
- F. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- G. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.4 FABRICATION:

- A. Mirror Sizes: To suit Project conditions, and before tempering, cut mirrors to final sizes and shapes.
- B. Cutouts: Fabricate cutouts before tempering for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.
- C. Mirror Edge Treatment: Flat polished.

- 1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
- 2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.
- D. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint as recommended in writing by film-backing manufacturer to produce a surface free of bubbles, blisters, and other imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION:

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.
- B. Clean contact surfaces with solvent and wipe dry.
- C. Seal porous mirror frames or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive sealant.
- D. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

3.3 INSTALLATION:

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
- B. Provide a minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- C. Wall-Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
 - 1. Top and Bottom Aluminum J-Channels: Provide setting blocks 1/8 inch (3 mm) thick by 4 inches (100 mm) long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch (6.4 mm) wide by 3/8 inch (9.5 mm) long at bottom channel.
 - 2. Top Channel/Cleat and Bottom Aluminum J-Channels: Fasten J-channel directly to wall and attach top trim to continuous cleat fastened directly to wall.
 - 3. Mirror Clips: Place a felt or plastic pad between mirror and each clip to prevent spalling

of mirror edges. Locate clips so they are symmetrically placed and evenly spaced.

- Install mastic as follows:
 - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
 - b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
 - c. After mastic is applied, align mirrors and press into place while maintaining a minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface.

3.4 CLEANING:

4.

- A. Remove wet glazing materials from finish surfaces.
- B. Remove labels after work is complete.
- C. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

3.5 ADJUSTING:

A. Remove and replace mirrors which are broken, chipped, cracked, abraded or damaged in any other way during the construction period, including natural causes, accidents and vandalism

3.6 **PROTECTION**:

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. After installation, mark pane with an 'X' by using removable plastic tape or paste.
- C. Do not permit edges of mirrors to be exposed to standing water.

END OF SECTION

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COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. This section applies to all floors identified in the contract documents as to receive the following types of floor coverings:
 - 1. Resilient tile and sheet.
 - 2. Carpet tile.
 - 3. Thin-set ceramic tile.
- B. Removal of existing floor coverings.
- C. Preparation of new concrete floor slabs for installation of floor coverings.
- D. Testing of concrete floor slabs for moisture and alkalinity (pH).

1.2 RELATED REQUIREMENTS:

- A. Section 01400 Quality Requirements: Additional requirements relating to testing agencies and testing.
- B. Section 03010 Maintenance of Concrete: For repair, resurfacing and cleaning of existing concrete surfaces.

1.3 REFERENCES:

- A. ASTM C109/C109M Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.
- B. ASTM C472 Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2014).
- C. ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- D. ASTM F1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.
- E. ASTM F2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2011.
- F. RFCI (RWP) Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.4 ADMINISTRATIVE REQUIREMENTS:

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.5 SUBMITTALS:

COMMON WORK RESULTS FOR FLOORING PREPARATION

- A. See Section 01330 Submittal Requirements, for submittal procedures.
- B. Visual Observation Report: For existing floor coverings to be removed.
- C. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- D. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.
 - 2. Summary of conditions encountered.
 - 3. Moisture and alkalinity (pH) test reports.
 - 4. Copies of specified test methods.
 - 5. Recommendations for remediation of unsatisfactory surfaces.
 - 6. Include certification of accuracy by authorized official of testing agency.
 - 7. Submit report to Architect.
 - 8. Submit report not more than two business days after conclusion of testing.
- E. Adhesive Bond and Compatibility Test Report.
- F. Copy of RFCI (RWP).

1.6 QUALITY ASSURANCE:

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.
 - 3. Allow at least 4 business days on site for testing agency activities.
 - 4. Achieve and maintain specified ambient conditions.
 - 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

1.7 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.
- 1.8 FIELD CONDITIONS:
 - A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
 - B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least

COMMON WORK RESULTS FOR FLOORING PREPARATION

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48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 - PRODUCTS

- 2.1 MATERIALS:
 - A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
 - 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 - 2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
 - 3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
 - B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

PART 3 - EXECUTION

- 3.1 CONCRETE SLAB PREPARATION:
 - A. Follow recommendations of testing agency.
 - B. Perform following operations in the order indicated:
 - 1. Preliminary cleaning.
 - 2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
 - 3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 5. Specified remediation, if required.
 - 6. Patching, smoothing, and leveling, as required.
 - 7. Consult the finish flooring manufacturer's instructions for acceptable substrate flatness tolerances.
 - 8. Other preparation specified.
 - 9. Adhesive bond and compatibility test.
 - 10. Protection.
 - C. Remediation:
 - 1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 - 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating over entire suspect floor area.
 - 3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to

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the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.2 REMOVAL OF EXISTING FLOOR COVERINGS:

- A. Comply with local, State, and federal regulations and recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to floor covering being removed.
- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.3 PRELIMINARY CLEANING:

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.4 MOISTURE VAPOR EMISSION TESTING:

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

3.5 INTERNAL RELATIVE HUMIDITY TESTING:

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as

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indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

F. Report: Report the information required by the test method.

3.6 ALKALINITY TESTING:

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
- C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
- D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.7 PREPARATION:

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with recommendations of testing agency.
- C. Comply with requirements and recommendations of floor covering manufacturer.
- D. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- E. Do not fill expansion joints, isolation joints, or other moving joints.
- 3.8 ADHESIVE BOND AND COMPATIBILITY TESTING:
 - A. Comply with requirements and recommendations of floor covering manufacturer.
- 3.9 APPLICATION OF REMEDIAL FLOOR COATING:
 - A. Comply with requirements and recommendations of coating manufacturer.
- 3.10 PROTECTION:
 - A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

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SECTION 09260

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Light gauge metal stud wall and ceiling framing with 20 gauge or lighter main studs.
- B. Metal channel suspended ceiling framing.
- C. Gypsum board.
- D. Taped and sanded joint treatment.

1.2 RELATED SECTIONS:

- A. Section 07213 Batt and Blanket Insulation for Batt sound (acoustical) insulation.
- B. Section 07900 Joint Sealants.

1.3 REFERENCES:

- A. ANSI A108.11 American National Standard for Interior Installation of Cementitious Backer Units; 2013.1.
- B. ANSI A118.9 American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2013.1.
- C. ANSI/ASTM C475 Joint Treatment Materials for Gypsum Wallboard Construction.
- D. ANSI/ASTM C630 Water Resistant Gypsum Backing Board.
- E. ANSI/ASTM C645 Nonstructural Steel Framing Members.
- F. ASTM C754 Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- G. ASTM C840 Standard Specification for Application and Finishing of Gypsum Board; 2013.
- H. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- I. ASTM C1280 Standard Specification for Application of Gypsum Sheathing; 2013.
- J. ASTM C1396/C1396M Standard Specification for Gypsum Board; 2013
- K. ASTM C1658/C1658M Standard Specification for Glass Mat Gypsum Panels; 2013.
- L. ASTM C1177/C1177M Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- M. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials;

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- N. GA-214 Recommended Levels of Gypsum Board Finish; 2010.
- O. GA-216 Application and Finishing of Gypsum Board; Gypsum Association; 2013.
- P. GA-226 Application of Gypsum Board to Form Curved Surfaces; Gypsum Association; 2008.
- Q. GA-600 Fire Resistance Design Manual; Gypsum Association; 2012
- R. USG's Gypsum Construction Handbook.
- S. UL (FRD) Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.
- T. ICBO (International Conference of Building Officials) Evaluation Report 4071
- U. International Building Code (IBC), 2012 Edition.

1.4 SUBMITTALS

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: Include manufacturer's literature on metal framing, ceiling suspension systems, gypsum board, joint tape and compound.
 - 1. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than twenty-five (25) years of documented experience.
- B. Installer Qualifications: Company specializing in performing, with minimum five (5) years of documented experience and approved by manufacturer.
- C. Regulatory Requirements: Comply with the applicable codes relating to the fire rated assemblies as shown on the drawings.
- D. Perform work in accordance with USG's Gypsum Construction Handbook.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Comply with GA-216 and Manufacturer's instructions.
- 1.7 REGULATORY REQUIREMENTS
 - A. Conform to applicable IBC for fire rated assemblies in conjunction with metal framing requirements of this section.

PART 2 - PRODUCTS

- 2.1 ACCEPTABLE MANUFACTURERS GYPSUM BOARD SYSTEM
 - A. United States Gypsum Co.

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- Β. Georgia Pacific.
- C. Pabco.
- D. National Gypsum.
- E. James Hardie Gypsum.
- F. Substitutions: See Section 01630 - Product Substitutions.

2.2 FRAMING MATERIALS

- Α. Studs and Tracks: ANSI/ASTM C645; galvanized, sizes and shapes shown on the drawings. Provide 20 gauge unless noted otherwise on drawings. Framing shown as 18 gauge or heavier is specified under Section 05400 - Cold Formed Metal Framing.
- Β. Backing: Galvanized sheet metal, 20 gauge unless noted otherwise.
- C. Resilient Channels: 25 ga. hat shaped formed steel.
- D. Furring Channels: 25 ga., 7/8" hat shaped formed steel.
- E. Ceiling Channels: 16 ga., 1-1/2" cold rolled galvanized steel.
- F. Hanger Wire: 8 ga. galvanized steel.
- G. Ceiling Struts: Pre-manufactured struts, specifically designed for horizontal restraint of suspended ceiling systems, similar to USG'S Donn Compression Posts. Site fabricated posts of 1/2 inch and 3/4 inch EMT may be used if fabricated and installed in accordance with ICBO Evaluation Report 4071 and acceptable to the governing authority
- H. Sheet Metal Backing: Provide backing plate, stud or proprietary backing members of type and configuration indicated on Drawings, and as follows:.0625 inch
 - 1. 16 gauge minimum galvanized steel sheet.
 - 2. 16 gauge minimum c-shaped steel stud.
 - 3. "Notch-Tite" and "Flush Mount" as manufactured by Metal Lite, Inc., 3070 E. Miraloma Avenue, Anaheim, CA 92806 (800) 886-6824.

2.3 GYPSUM BOARD MATERIALS

- Α. Gypsum Wallboard:
 - Application: Use for vertical surfaces and ceilings, unless otherwise indicated. 1.
 - 2. Glass mat faced gypsum panels as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board. 3.
 - Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
 - Mold resistant board is required at all locations. b.
 - At Assemblies Indicated with Fire-Rating: Use type required by indicated tested 4. assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 5. Thickness:
 - Vertical Surfaces: 5/8 inch. a.
 - b. Ceilings: 5/8 inch.
 - Multi-Layer Assemblies: Thicknesses as indicated on drawings. C.

- B. Backing Board For Wet Areas:
 - 1. Application: Surfaces behind tile in wet areas including drinking fountains etc.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. ASTM Cement-Based Board: Non-gypsum-based, cementitious board complying with ASTM C1288.
 - a. Thickness: 5/8 inch.
 - 4. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
 - a. Standard Type: Thickness 1/4 or 5/8 inch.
 - b. Fire Resistant Type: Type X core, thickness 5/8 inch.
- C. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
 - 1. Application: Vertical surfaces behind thinset tile, except in wet areas.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 4. Type: Regular and Type X, in locations indicated.
 - 5. Type X Thickness: 5/8 inch.
 - 6. Regular Board Thickness: 5/8 inch.
 - 7. Edges: Tapered.
- D. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Ceilings, unless otherwise indicated.
 - 2. Thickness: 5/8 inch.
 - 3. Edges: Tapered.

2.4 ACCESSORIES:

- A. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
 - 1. Types: As detailed or required for finished appearance.
 - 2. Special Shapes: In addition to conventional corner bead and control joints, provide Ubead at exposed panel edges.
 - 3. Corner Beads: GA216; Type CB; electro-galvanized steel.
 - 4. Edge Trim: GA216; Type L bead; electro-galvanized steel and Type LC rolled-formed zinc. Milcore No. 66 J-metal edge, or as approved by Architect, at unfinished gypsum board edges against other finish materials.
 - 5. Control Joint: U.S. Gypsum No. 093, roll-formed zinc.
 - 6. Manufacturers Finishing Accessories:
 - a. Same manufacturer as framing materials.
 - b. Phillips Manufacturing Co: www.phillipsmfg.com.
 - c. U.S. Gypsum.
- B. Joint Materials: ANSI/ASTM C475; reinforcing tape, joint compound, adhesive, water, and fasteners.
 - 1. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 - 2. Ready-mixed vinyl-based joint compound.
- C. Texture Material: Spray-applied, compatible with joint system.
 - 1. As manufactured by USG, multi-purpose, pre-packaged, non-asbestos type.
- D. Fasteners: ASTM C1002 Type S for 20 gage and lighter metal studs, complying with IBC requirements.
 - 1. Type G for fastening to gypsum board.

- 2. Type S for fastening to light gauge steel framing.
- E. Drywall Primer:
 - 1. Paint material specifically formulated to fill the pores and equalize the suction difference between gypsum board surface paper and the compound used on finished joints, angles, fastener heads and accessories and over skim coatings.
 - 2. Drywall primer which is applied to the finished surface of the work specified in this section shall be provided as specified under Sections 09 90 00 and 09 72 00 as applicable.
 - 3. A good quality, white latex drywall primer formulated with high binder solids, applied undiluted, and shall be applied to gypsum board surfaces prior to the application of texture materials.
- F. Accessories for Tile Backer Units:
 - 1. Fasteners: Stainless steel drill screws of size and type recommended by tile backer unit manufacturer for fastening tile backer units to metal studs as indicated.
 - 2. Joint Tape for Cementitious Backer Units: As recommended by cementitious backer unit manufacturer and complying with ANSI A118.9 and ANSI A108.11.
 - 3. Veneer Plaster: Diamond Brand Veneer Basecoat Plaster and USG Plaster Bonder as manufactured by United States Gypsum Co.
- G. Acoustic Insulation: As specified in Section 07212.
- H. Acoustical Sealant: As specified in Section 07900.
- I. Outlet Acoustical Box Pad: As specified in Section 07900.
- J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I Inorganic.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that site conditions are ready to receive work.
- B. Beginning of installation means acceptance of substrate.

3.2 METAL STUD INSTALLATION:

- A. Accurately layout partition and wall lines from the dimensions shown on the Drawings.
- B. Install metal studs and accessories in accordance with the recommended industry practices included in USG's Gypsum Construction Handbook and ASTM C754.
- C. Align partition and wall assemblies to a tolerance of one in 200 horizontally and one in 500 vertically.
- D. Space studs as required for compliance with pertinent regulations and as noted on drawings. Space studs at 16" O.C. if not noted elsewhere.
- E. Provide minimum three studs at all corners and provide double studs at all wall openings, door and window jambs.
- F. Provide sheet metal backing/blocking for support of all wall mounted equipment and fixtures

including, but not limited to, plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, handrails, grab bars, mirrors, marker and tack boards, draperies and other wall mounted items.

- G. Coordinate with other trades for proper size, spacing, thickness and attachment requirements. Provide 20 gauge sheet metal unless otherwise shown on the drawings or required by a specific item.
- H. Coordinate requirements for pipes, ducts, conduits and other items required to be enclosed within the partition and wall system.
- I. Blocking: Use steel channels secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and other wall mounted items.
- J. Use sheet metal backing, 16 gauge minimum for reinforcement of all wall mounted items and items requiring backing per manufacturer's instructions.

3.3 CEILING INSTALLATION:

- A. Install ceiling suspension system in accordance with recommended industry practices included in USG's Gypsum Construction Handbook, and ASTM C754.
- B. Install system capable of supporting imposed loads to a deflection of 1/360 maximum.
- C. Install after major above ceiling work is complete. Coordinate the location of hangers with other work.
- D. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- F. Space hanger wires as required by IBC for carrying channel spacing.
- G. Install carrying channels at 48" O.C. and within 6" of walls. Provide 1" clearance between channels and abutting walls.
- H. Lap channels 12" at splices.
- I. Install furring channels at right angles to carrying channels at 16" O.C. and within 6" of walls and maintain 1" clearance to walls.
- J. Secure channels and splices with 18 ga. tie wire.
- K. Reinforce openings in ceiling which interrupt carrying or furring channels with lateral channel bracing.
- L. Provide horizontal restraint consisting of:
 - 1. Four No. 12 gauge wires secured to main runners within 2 inches of cross runner intersection and splayed 90 degrees from each other at an angle not exceeding 45 degrees from the plane of the ceiling.
 - 2. Struts fastened to the main runner extending to and fastening to structure above. Place struts 12 feet on center in both directions with the first point within 6 feet from

each wall.

3.4 ACOUSTICAL ACCESSORIES INSTALLATION:

- A. Install acoustical sealant within partitions where indicated on drawings, and where walls all called out to have acoustical batt insulation. Install continuous beads of acoustical sealant to produce an airtight seal at intersections of partitions with floors, ceilings, walls, columns and all abutting construction so that the entire perimeter is sealed. At openings and cut outs, fill spaces between gypsum board and ducts, pipes and other penetrating items with acoustical sealant.
- B. Electrical Boxes: Provide where indicated on drawings and at all wall types designated as acoustical partitions. Wrap completely in self-adhesive acoustical box pads. Leave no gaps.

3.5 GYPSUM BOARD INSTALLATION:

- A. Comply with ASTM C 840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Install gypsum board in accordance with manufacturer's instructions, recommended industry practices included in USG's Gypsum Construction Handbook and in accordance with requirements of assembly rating where rated construction is called for.
 - 1. Install moisture resistant gypsum board at all wall locations that receive ceramic tile.
 - 2. Install 5/8 inch thick, type X gypsum board at all other wall locations.
- C. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 - 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- D. Double-Layer Non-Rated: Use gypsum board for first layer, placed perpendicular to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to first layer. Offset joints of second layer from joints of first layer. Secure the second layer to the first layer with adhesive and support to hold in place.
- E. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- F. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with waterresistant sealant.
- G. Use screws when fastening gypsum board to metal furring or framing. Screw fasteners to conform to IBC requirements for type of screw and screw spacing.
- H. Treat cut edges and holes in moisture resistant gypsum board and exterior gypsum ceiling board with sealant.
- I. Place control joints consistent with lines of building spaces, and at a maximum of 30 feet center to center. Also place control joints where base wall construction contains building control or expansion joints.
- J. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials as indicated. Miter corners of a trim and reveal mouldings.
- K. Gypsum board shall be held 1/8 inch maximum off of the finish floor and set in a bead of silicone sealant. Any gaps between the finish floor and bottom of gypsum board that exceeds

1/8 inch in fire rated walls shall be filled with a fire sealant at the expense of the Contractor.

3.6 JOINT TREATMENT:

- A. Glass Mat Faced Gypsum Board: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.
- B. Provide tape and joint compound finish at all exposed joints edges and corners to produce smooth surface ready to receive finishes. Finish shall be Gypsum Associations Level 4 Finish system as follows:
- C. Apply tape pressed into joint compound or by mechanical tool designed for this process. Apply joint compound to all fastener heads and accessories.
- D. Apply second coat of joint compound to extend beyond joint center approximately 3-1/2 inches. Apply to a smooth even plane. After drying or setting sand or smooth as needed to eliminate high spots or excessive compound. Apply joint compound to all fastener heads and accessories.
- E. Apply third coat of joint compound except at concealed locations not subject to view. Third coat shall be applied to feather edges approximately 6 inches from center of joint. After drying, lightly sand to leave a smooth even surface. Apply joint compound to all fastener heads and accessories.
- F. Provide spray-applied texture to all gypsum board exposed to view.
 - 1. Spray apply finish texture coating (light orange peel as approved by Architect) in accordance with manufacturer's instructions.
 - 2. Remove any texture droppings or overspray from door frames, windows and other adjoining work.

3.7 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
 - 2. At exterior soffits, not more than 30 feet apart in both directions.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

3.8 TOLERANCES:

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09300

TILE

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Ceramic tile floor and base finishes.
 - B. Ceramic tile wall finishes.

1.2 RELATED SECTIONS:

- A. Section 07900 Joint Sealers.
- B. Section 09260 Gypsum Board Systems: Tile backer board.

1.3 REFERENCES:

- A. ANSI A108 Series/A118 Series/A136.1 American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2012.
- B. ANSI A137.1 American National Standard Specifications for Ceramic Tile; 2012.
- C. ANSI A137.2 American National Standard Specifications for Glass Tile; 2012.
- D. TCNA (HB) Handbook for Ceramic, Glass, and Stone Tile Installation; 2014.
- E. ASTM C150 Standard Specification for Portland cement; 2015.
- F. ASTM C206 Standard Specification for Finishing Hydrated Lime.

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: Indicate material specifications, characteristics, and instructions for using mortars and grouts.
- C. Shop Drawings: Indicate color arrangement, perimeter conditions, junctions with dissimilar materials, thresholds, setting details and expansion joints.
- D. Samples: Mount tile and apply grout on one plywood panel, to indicate pattern, color variations, and grout joint size variations of each tile type.
- E. Test Reports: Submit reports on sand indicating conformance to ASTM C144. Owner reserves the right to sample and conduct quality assurance tests on on-site materials.
- F. Submit manufacturer's certification under provisions of this Section that the materials supplied conform to ANSI A137.1.
- G. Submit manufacturer's installation instructions.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

- 1. Extra Tile: 1 percent of each size, color, and surface finish combination, but not less than 10 of each type. Extra materials shall be furnished in original packaging.
- 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.5 QUALITY ASSURANCE:

- A. Manufacturer: Company specializing in the manufacture of products specified in this Section with minimum ten (10) years documented experience.
- B. Installer: Company specializing in applying the work of this Section with minimum five (5) years documented experience.
- C. Maintain one copy of and ANSI A108/A118/A136.1 and TCNA (HB) on site.
 - 1. Conform to ANSI/TCNA A137.1
 - 2. Conform to TCNA Handbook for Ceramic Tile Installation.
- D. Dynamic Coefficient of Friction (DCOF): Provide floor tile products and finished floor tile installation with a wet DCOF of 0.42 minimum for level surfaces and treads of stairs, per ANSI 137.1.
- 1.6 DELIVERY, STORAGE AND HANDLING:
 - A. Deliver products to site and store under provisions of Section 01600.
 - B. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.
- 1.7 ENVIRONMENTAL REQUIREMENTS:
 - A. Do not install adhesives in a closed, unventilated environment.
 - B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

1.8 WARRANTY:

- A. Correct defective Work within a five year period after Date of Substantial Completion.
- B. The Contractor warrants the work of this Section to be in accordance with the Contract Documents and free from faults and defects in materials and workmanship for a period of 25 years. The manufacturer of adhesives, mortars, grouts and other installation materials shall provide a written twenty five (25) year warranty, which covers materials and labor.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS:
 - A. TILE:
 - 1. Dal Tile Co.
 - 2. American Olean Tile Co.
 - B. SETTING MATERIAL
 - 1. Mapei
 - 2. Laticrete

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CERAMIC TILE

- C. Single Source Responsibility:
 - 1. Source Limitations for Setting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout from single manufacturer and each aggregate from single source or producer.
 - a. Obtain setting materials, waterproof membrane, and crack isolation membrane, from single manufacturer.
 - 2. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
 - a. Stone thresholds.
 - b. Tile backer units.
 - c. Metal edge strips.
- D. Substitutions: See Section 01630 Product Substitutions.

2.2 TILE MATERIAL:

- A. Provide tile in the locations and of the types, colors and pattern indicated on the Drawings and identified in the Material Schedule.
 - 1. Ceramic Wall Tile: ANSI/TCNA A137.1, ____ inch square nominal, matt glazed with matching 1/4 inch radius edge trim pieces and 4 inch coved base, color as shown on drawings.
 - 2. Ceramic Porcelain Tile: ANSI/TCNA A137.1, color, style and size as scheduled on finish schedule.

2.3 SETTING MATERIAL:

- A. All setting material shall be by the same manufacturer.
- B. No organic adhesives shall be use.
- C. Waterproofing and Crack Isolation Membrane: Meeting requirements of ANSI A118.10.
 - 1. Mapei "Mapelastic" PRP M19 liquid rubber latex with fiber reinforcing fabric.
 - 2. Laticrete "9235 Waterproof Membrane" with fiber reinforcing fabric.
- D. Thin Set Mortar: Meeting requirements of ANSI A118.4.
 - 1. Mapei "Kerabond" flexible latex-Portland cement mortar with "Keralastic" polymer additive.
 - 2. Laticrete "211 Crete Filler Powder" gauged with "4237 Latex Thin Set Mortar Additive".
- E. Grout: Meeting requirements of ANSI A118.6
 - 1. Mapei "Ultra/Color" unsanded grout
 - 2. Laticrete floor or wall grout gauged with "1776" admix plus.

2.4 ACCESSORIES:

- A. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
 - 1. Applications:
 - a. Open Edges: Bullnose.
 - b. Inside Corners: Jointed.
 - c. Floor to Wall Joints: Cove base.
 - 2. Manufacturers: Same as for tile.
- B. Non-Ceramic Trim: Color as noted on the drawings or in the ID Specifications, style and dimensions to suit application, for setting using tile mortar or adhesive.
 - 1. Applications:

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CERAMIC TILE

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- a. Open edges of wall tile.
- b. Open edges of floor tile.
- c. Transition between floor finishes of different heights.
- d. Thresholds at door openings.
- e. Floor to wall joints.
- f. Borders and other trim as indicated on drawings.
- 2. Manufacturers:
 - a. Schluter-Systems: www.schluter.com.
- C. Thresholds: Marble or Granite, white or gray, honed finish; 2 inches wide by full width of wall or frame opening; 1/2 inch thick; beveled one long edge with radiused corners on top side; without holes, cracks, or open seams.
 - 1. Marble: Complying with ASTM C 503 with a minimum abrasive hardness of 10 when tested in accordance with ASTM C 241.
 - 2. Granite: complying with ASTM C 615.
 - 3. Applications:
 - a. At doorways where tile terminates.
 - b. At open edges of floor tile where adjacent finish is a different height.
- D. Sealer: Approved by tile manufacturer, equal to Summitville SL-15 Seal Penetrating Grout and Tile Sealer.
- E. Joint Sealer: Polyurethane sealer as specified for horizontal and vertical concrete in Section 07900 Joint Sealers.

PART 3 - EXECUTION

- 3.1 EXAMINATION:
 - A. Verify that surfaces are ready to receive work.
 - B. Beginning of installation means installer accepts condition of existing substrate.

3.2 PREPARATION:

- A. Protect surrounding work from damage or disfiguration.
- B. Vacuum clean existing substrate and damp clean.
- C. Seal substrate surface cracks and any other holes or cavities with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Mix mortar in accordance with manufacturer's instructions and recommendations of TCNA.

3.3 CERAMIC FLOOR TILE INSTALLATION - THINSET METHOD:

- A. Ceramic floor tile shall be installed using a thin set, latex-Portland cement mortar (ANSI A118.4) and using a standard Portland cement grout (ANSI A118.6). Installation shall be in accordance with TCNA Handbook for Ceramic Tile Installation, Handbook Method Number TCNA F113.
- B. Lay tile to pattern indicated on drawings. Do not interrupt tile pattern around openings. Align wall, base and floor joints. Coordinate tile pattern and location with subfloor joints including saw-cut joints.

- C. Provide tile joints over all subfloor joints. Do not bridge subfloor joints with any tile. Cut backing of tile sheets at all expansion and control joints.
- D. Provide bullnosed tile at exposed tile edges and elsewhere where shown on the drawings.
- E. Cut and fit tile tight to penetrations through tile. Form corners and bases neatly. Align floor, base and wall joints. Center in area.
- F. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep control, construction and expansion joints free of adhesive or grout.
- I. Allow tile to set for a minimum of forty-eight (48) hours prior to and after grouting.
- J. Grout tile joints.
- K. Seal grout with grout manufacturer's approved sealer.
- L. Apply sealant to junction of tile and dissimilar materials and at junction of dissimilar planes.
- M. Seal grout joints and all unglazed tile. Sealer to be applied immediately after tile installation for protection of grout during remainder of construction.
- N. At all subfloor joints, provide tile joints in accordance with TCNA EJ171. Provide polyurethane joint sealer and backing rod as specified in Section 07900 Joint Sealers for horizontal and vertical concrete. Joints include isolation, expansion, construction and contraction joints.

3.4 CERAMIC WALL TILE INSTALLATION:

- A. Where installed on metal stud and gypsum board construction, installation shall be in accordance with TCNA Handbook for Ceramic Tile Installation, Handbook Method Number TCNA W243.
- B. Lay tile to pattern indicated on drawings. Do not interrupt tile pattern around openings. Coordinate tile pattern and location with substrate joints.
- C. Align wall, base, and floor joints. Provide tile joints over all substrate joints. Do not bridge substrate joints with any tile. Cut backing of tile sheets at all expansion and control joints.
- D. Form internal angles coved and external angles bullnosed.
- E. Cut and fit tile tight to penetrations through tile. Form corners and bases neatly.
- F. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar or excess grout.
- G. Form internal angles coved and external angles bullnosed.
- H. Sound tile after setting. Replace hollow sounding units.
- I. Keep control, construction and expansion joints free of mortar or grout.

- J. Allow tile to set for a minimum of forty-eight (48) hours prior to grouting
- K. Grout tile joints.
- L. Seal grout with grout manufacturer's approved sealer.
- M. Apply sealant to junction of tile and dissimilar materials and at junction of dissimilar planes.
- N. Seal grout joints and unglazed tile. Sealer to be applied immediately after tile installation for protection of grout during remainder of construction.
- O. At all substrate joints, provide tile joints in accordance with TCNA EJ171. Provide polyurethane joint sealer and backing rod as specified in Section 07900 Joint Sealers for horizontal and vertical concrete. Joints include isolation, expansion, construction and contraction joints.

3.5 CLEANING:

- A. Clean work under provisions of 01700.
- B. Clean tile surfaces.

3.6 PROTECTION:

- A. Do not permit traffic over finished floor surface for seven (7) calendar days.
- B. Sealer shall be applied to all grout joints and unglazed tile before traffic is allowed over area.

END OF SECTION

SECTION 09511

ACOUSTICAL CEILINGS

PART 1 - GENERAL

- 1.1 SECTION INCLUDES
 - A. Suspended metal grid ceiling system.
 - B. Acoustical panels.
- 1.2 RELATED SECTIONS:
 - A. Section 07212 Batt and Blanket Insulation: Acoustical insulation.
 - B. Section 08305 Access Doors and Panels: Access panels
 - C. Division 15 Mechanical.
 - D. Division 16 Electrical.

1.3 REFERENCES:

- A. ASCE 7 Minimum Design Loads for Buildings and Other Structures, Section 13.5.
- B. ASTM C635/C635M Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- C. ASTM C636/C636M Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; 2013.
- D. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- E. ASTM E580/E580M Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2014.
- F. CISCA Guidelines for Seismic Restraint for Direct Hung Suspended Ceiling Systems, Seismic Zones 3 and 4.
- G. CISCA Recommendations for Direct-Hung Acoustical Tile and Lay-In Panel Ceilings, Seismic Zones 0-2.
- H. ICBO (International Conference of Building Officials) Evaluation Report 4071
- I. International Building Code (IBC), 2012 Edition, with Local Amendments.
- J. NFPA 286 Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2011.
- K. UL (FRD) Fire Resistance Directory; Underwriters Laboratories Inc.; Current edition.

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data:
 - 1. Submit manufacturer's data on acoustical units.
 - 2. Provide data on suspension system components, trim system.
- C. Shop Drawings:
 - 1. Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.
- D. Samples:
 - 1. Submit six (6) samples illustrating material and finish of acoustic units of each panel and tile type and
 - 2. Two (2) samples, 6 inches long, of suspension system main runner, cross runner and edge trim.
- E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention and anchorage requirements.
- F. Certifications: Manufacturer's certifications that system complies with specified requirements:
 1. For seismic performance: International Code Council Evaluation Report.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: To obtain Lifetime ceiling system warranty, 30-year ceiling system warranty, color match or ceiling panel and suspension system compatibility, all acoustical panel and suspension system components shall be produced and supplied by one manufacturer. Materials supplied by more than one manufacturer are not acceptable
- B. Source quality control:
 - 1. Test reports: Manufacturer will provide test certification for minimum requirements as tested in accordance with applicable industry standards and/or to meet performance standards specified by various agencies.
 - 2. Changes from system: System performance following any substitution of materials or change in assembly design must be certified by the manufacturer.
 - 3. All ceiling panel cartons must contain UL label for acoustical compliance.
 - 4. All suspension system cartons must contain UL label for load compliance per ASTM C635.
- C. Manufacturer: Company specializing in manufacture of ceiling suspension system and ceiling tile with ten (10) years minimum experience.
- D. Installer: Company with five (5) years minimum, documented experience.
- E. Seismic Performance:

a.

1.

- Provide acoustical ceiling system that has been evaluated by an independent party and found to be compliant with the 2012 International Building Code, Seismic Category C.
 - Tested per International Code Council Evaluation Services AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components as evidenced by International Code Council Evaluation Report, ESR-1308
- F. Requirements of regulatory agencies: Codes and regulations of authorities having jurisdiction.

1.6 REGULATORY REQUIREMENTS

- A. Conform to IBC, ASCE and CISCA requirements for Seismic Design Category listed in Design Data on Drawings.
 - 1. For Seismic Design Category C: Comply with CISCA Recommendations for Seismic Zones 0-2.
 - 2. Alternative design and installation requirements included in ICC Evaluation Report ESR-1222 may be utilized provided all the requirements of the Evaluation Report are met.
- B. Conform to IBC for fire rated assembly and combustibility requirements for materials.
- C. Fire Performance Characteristics: Identify components with markings of applicable testing organization.
- D. Surface Burning Characteristics: Tested in accordance with ASTM E 84.
 - 1. Flame Spread: 25 or less
 - 2. Smoke Developed: 50 or less.
- E. Fire Resistance Ratings: Indicated by reference to design designations in UL Fire Resistance Directory, tested per ASTM E 119

1.7 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - 1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.
 - 2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Maintain uniform temperature of minimum 60 degrees F and humidity of 20 to 40 percent prior to, during, and after installation.

1.9 WARRANTY

- A. Provide manufacturer's standard warranties agreeing to repair or replace acoustical panels and suspension systems that fail within the warranty period. Failures include manufacturing defect, sagging and warping of acoustical panels, and rusting of grid system.
 - 1. Warranty Period:
 - a. Acoustical Panels: Manufacturer's standard maximum warranty for each type of panel used.
 - b. Grid and Suspension System: Manufacturer's standard maximum warranty, but not less than 10 years.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS:
 - A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.
 - 1. Armstrong.
 - 2. USG Interiors.

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- 3. Chicago Metallic Corp.
- 4. Celotex Corporation.
- B. Substitutions: See Section 01630 Product Substitutions.
- 2.2 ACOUSTICAL UNITS GENERAL: ASTM E1264, CLASS A.
 - A. Provide panel products matching existing units indicated on Drawings and complying with the following:
 - 1. Light reflectance of LR-1 (over 75 percent), per Fed. Spec. SS-S-118B and ASTM E1264 for factory finished panels. Field painted panels are not required to comply.

2.3 SUSPENSION SYSTEM :

- A. Suspension Systems General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
 - 1. Suspension system shall support the ceiling system specified with a maximum deflection of 1/360 of the span.
- B. Components: Main beams and cross tees In accordance with the 2012 International Building Code,
 - 1. Structural Classification: ASTM C635, Intermediate Duty.
 - 2. Exposed Tee System 15/16"
 - 3. Main-Runners: Minimum of 1.64 inch in height with an exposed capped face of width of 15/16 inch, unless otherwise indicated on Drawings.
 - 4. Cross-Tees: Minimum of 1-1/2 inch or 1-1/4 inch in height with an exposed capped face in a width to match main runners.
 - 5. Finish: Exposed faces of main and cross runners shall be a baked enamel paint finish, Colors as follows:
 - a. White and match the actual color of the selected ceiling tile, unless noted otherwise.
- C. Attachment Devices: Size for five times design load indicated in ASTM C635, Table 1, Direct Hung unless otherwise indicated.
- D. Accessories: Provide edge trim, hanger wires, support channels and other accessories as required for a complete system in size and configuration shown on drawings and in accordance with IBC requirements.
- E. Exposed Trim and Accessories: Formed steel finished to match grid.
- F. Hangers and Supports: Galvanized steel. Hangers not less than 12 gauge.
- G. Ceiling Struts: Pre-manufactured struts, specifically designed for horizontal restraint of suspended ceiling systems, similar to USG'S Donn Compression Posts. Site fabricated posts of 1/2 inch and 3/4 inch EMT may be used if fabricated, installed in accordance with ICBO Evaluation Report ER-4071, and acceptable to the governing authority.
- H. Hold-Down Clips: Provide access type hold-down clips where required by Acoustical Ceiling Manufacturer for type and condition and where panels weigh less than one pound per square foot.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that existing conditions are ready to receive work.
- B. Verify that layout of hangers will not interfere with other work.
- C. Coordinate installation in areas containing major ductwork.
- D. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Do not install acoustical ceilings until building is enclosed, sufficient heat is provided, dustgenerating activities have terminated, and overhead work is completed, tested, and approved.
- B. Schedule installation of acoustic units after interior wet work is dry.

3.3 INSTALLATION

- A. Install system in accordance with ASTM C636, IBC, ASCE and CISCA requirements for designated Seismic Design Category and as supplemented in this Section. Alternative installation designs included in ICC Evaluation Reports ESR-1222 or ESR-1308 are acceptable if all the requirements of the reports are met.
- B. Install system capable of supporting imposed loads to a deflection of 1/360 maximum and in accordance with the details on the drawings.
- C. Install after major above ceiling work is complete. Coordinate the location of hangers with other work.
- D. Provide hangers and inserts as required. Submit detail of hanging/block reinforcement to Architect prior to commencing work.
- E. Hang system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
 - 1. For Seismic Design Category C: Sprinkler heads and other penetration shall have a minimum of 1/4 inch clearance on all sides.
- F. Where ducts or other equipment prevent the regular spacing of hangers, trapeze above or below interfering members.
- G. Locate system on room axis according to reflected plan.
- H. Do not eccentrically load system, or produce rotation of runners.
- I. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner, or support components independently.
- J. Install edge molding at intersection of ceiling and vertical surfaces, using longest practical lengths. Miter corners. Provide edge moldings at junctions with other interruptions.
- K. Form expansion joints as required. Form to accommodate plus or minus one-inch movement. Maintain visual closure.
- L. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance

and function.

- M. Install acoustic units, level, in uniform plane, and free from twist, warp, and dents.
- N. Provide lateral force bracing consisting of splayed wire restraints and struts as required by IBC and ASTM C636 and ASTM E580.
 - 1. Four No. 12-gauge wires secured to main runners within 2 inches of cross runner intersection and splayed 90 degrees from each other at an angle not exceeding 45 degrees from the plane of the ceiling.
 - 2. Struts fastened to the main runner extending to and fastening to structure above. Place struts 12 feet on center in both directions with the first point within 6 feet from each wall.

3.4 LIGHTING FIXTURES:

- A. All light fixtures shall be mechanically attached to the suspension system per NEC 410-16 (two per fixture unless the fixture is independently supported).
- B. Support of rigid lay-in or can light fixtures:
 - 1. Each fixture less than 10 lbs. shall have a single wire (wire may be slack) attached from the fixture to structure.
 - 2. Each fixture that weighs between 10 and 56 lbs. shall have two wires (wires may be slack) attached at diagonal corners of the fixture to structure.
 - 3. Each fixture greater than 56 lbs. shall be directly supported to structure by approved hangers.
 - 4. Pendant light fixtures shall be directly supported from structure with 9-gauge wire (or approved alternative).

3.5 AIR TERMINALS:

- A. Air terminals less than 20 lbs. shall be positively attached to the suspension system
- B. Air terminals that weigh between 20 and 56 lbs. shall be mechanically attached to the suspension system. Two slack wires shall be attached from the housing to structure.
- C. Air terminals in excess of 56 lbs. shall be directly supported to structure by approved hangers.

3.6 SPRINKLER HEADS AND OTHER PENETRATIONS:

A. Shall have 3/8" clearance on all sides

3.7 TOLERANCES

- A. Variation from Flat and Level Surface: 1/8 inch in 10 ft.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09650

RESILIENT FLOORING AND BASE

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Vinyl Composition Tile.
 - B. Resilient base.

1.2 RELATED REQUIREMENTS:

- A. Refer to Section 01230 Alternates.
- B. Section 09056 Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

1.3 REFERENCES:

- A. ASTM D2240 Standard Test Method for Rubber Property—Durometer Hardness: 65 Shore A.
- B. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- C. ASTM E648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c
- D. ASTM E662 14 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials; 2014.
- E. ASTM F150-06 Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring; 2013.
- F. ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- G. ASTM F1066 Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2014) e1.
- H. ASTM F1303 Standard Specification for Sheet Vinyl Floor Covering with Backing; 2004 (Reapproved 2014).
- I. ASTM F1861 Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012) e1.
- J. International Building Code (IBC), 2012 Edition with Local Amendments.

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: Provide data for each specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
 1. Include information stating Static Coefficient of Friction.

- 2. MSDS
 - a. Submit Material Safety Data Sheets (MSDS) available for flooring products, adhesives, patching/leveling compounds, floor finishes (polishes) and cleaning agents.
- C. Shop Drawings: Indicate seaming plan, coving details.
- D. Samples: Submit two (2) samples, 12 x 12 inches (nominal) in size, illustrating color and pattern for each floor tile.
- E. Samples: Submit two (2) samples of base material for each color specified.
- F. Concrete Testing Standard: Submit a copy of ASTM F710.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01600 Product Requirements, for additional provisions.
 - 2. Extra Flooring Material: 40 square feet of each type and color.
 - 3. Extra Wall Base: 25 linear feet of each type and color.

1.5 QUALITY ASSURANCE:

- A. Single-Source Responsibility: provide types of flooring and accessories supplied by one manufacturer, including leveling and patching compounds, and adhesives.
- B. Select an installer who is competent in the installation of resilient and static dissipative resilient tile flooring.
- C. Provide static dissipative resilient tile, static dissipative adhesive, copper grounding strips, and static dissipative floor finish supplied by the manufacturer.
- D. Provide flooring material to meet the following fire test performance criteria as tested by a recognized independent testing laboratory:
 - 1. ASTM E 648 Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I.
 - 2. ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less.
- E. Slip resistance of floor surfaces and changes in level shall be in accordance with applicable law.

1.6 OPERATION AND MAINTENANCE DATA:

- A. Submit cleaning and maintenance data under provisions of Section 01700.
- B. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing and precautions against cleaning materials and methods detrimental to finishes and performance.
- C. Warranty: Provide warranty documents specified herein from all manufacturers.

1.7 REGULATORY REQUIREMENTS:

- A. Conform to IBC for flame/ fuel/smoke rating requirements of resilient flooring in accordance with ASTM E648 and E662.
- 1.8 DELIVERY, STORAGE, AND HANDLING:
 - A. Protect roll materials from damage by storing on end.

- B. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- C. Store materials in a clean, dry, enclosed space off the ground, and protected from the weather and from extremes of heat and cold. Protect adhesives from freezing.
 - Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

1.9 ENVIRONMENTAL REQUIREMENTS:

- A. Store materials for three (3) calendar days prior to installation in area of installation to achieve temperature stability.
- B. Maintain ambient temperature required by adhesive manufacturer three (3) calendar days prior to, during, and 24 hours after installation of materials.

1.10 WARRANTY:

- A. See Section 01770 Closeout Procedures, for additional warranty requirements.
- B. Resilient
 - 1. Resilient Flooring: Submit a written warranty executed by the manufacturer, agreeing to repair or replace resilient flooring that fails within the warranty period.
- C. Warranty Period
 - 1. Warranty Period: 5 years
- D. Rights
 - 1. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS FLOORING TILE:
 - A. Basis of Design: Johnsonite, a Tarkett Company: www.johnsonite.com.
 - B. Substitutions: Under provisions of Section 01630.

2.2 FLOOR TILE MATERIALS:

- A. Vinyl Tile Flooring
 - 1. Vinyl Composition Tile (VCT): Tile composed of polyvinyl chloride resin, plasticizers, fillers, stabilizers and pigments with colors and texture dispersed uniformly throughout its entire thickness, and conform to the requirements of ASTM F 1066, 'Standard Specification Vinyl Composition Floor Tile", Class 2, through-pattern.
- 2.3 Alternate No.3: Resilient Rubber Athletic Tile Flooring with the following physical characteristics:
 - A. Complies with requirements for ASTM F1344 Standard Specification for Rubber Floor Tile Class 1-A and 1-B.

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- B. Tile manufactured of dual durometer layers composed of 100% synthetic and natural rubber.
- C. Tile is two-ply vulcanized construction which incorporates a rubber wear layer and an elastic cushioned performance layer.
- D. Wear layer thickness: .090" (2.3 mm).
- E. Overall thickness: 3/8" [.375" (9.5 mm)].
- F. Tile design, texture, and color:
 - 1. Square Edge (glue down) Hammered Texture.
 - 2. Solid Color.
- G. Tile size: 1. Square Edge (glue down) 24" X 24" (61 cm X 61 cm).
- H. ASTM D2047, Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring of 0.6 or greater.
- I. ASTM F970, Standard Test Method for Static Load Limit passes 250 PSI.
- J. ASTM D3389 Standard Test Method for Coated Fabrics Abrasion Resistance: < 1.00 gram weight loss.
- K. ASTM E648, Standard Test method for Critical Radiant Flux of 0.45 watts/cm² or greater, Class I.
- L. Phthalate, chlorine and halogen-free.

2.4 MANUFACTURERS – RESILIENT BASE

- A. Basis of Design: Johnsonite, a Tarkett Company: www.johnsonite.com.
- B. Acceptable Manufacturers:
 - 1. Roppe Corp: <u>www.roppe.com</u>.
 - 2. Burke Flooring: <u>www.burkemercer.com</u>.
 - 3. Armstrong World Industries, <u>www.armstrong.com</u>
- C. Substitutions: See Section 01630 Product Substitutions.

2.5 RESILIENT BASE MATERIALS

- A. Resilient Base: ASTM F-1861, Type TS, Group 1, thermoset vulcanized extruded rubber; 4 inch high; 1/8 inch thick; standard toe, color as shown on drawings.
 - 1. Length: Roll
 - 2. Color (s): As indicated on Drawings and Material Schedules.
- B. Accessories: Premolded external corners, internal corners, and end stops.

2.6 ACCESSORIES:

- A. Subfloor Filler: Cementitious, non-shrinking latex fortified hydraulic cement patching compound recommended by flooring material manufacturer.
- B. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.

- 1. Resilient Rubber Athletic Flooring (For glue down tile only).
 - a. Johnsonite 965 Flooring and Tread Adhesive
 - b. Johnsonite 975 Two-Part Urethane Adhesive
 - c. Johnsonite 140 SpraySmart Adhesive
- C. Edge Strips: Vinyl edge strips appropriate for transition to adjacent material. Provide reducer strips where elevation difference occurs. Color as selected by Architect.
- D. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 - EXECUTION

- 3.1 EXAMINATION:
 - A. Verify that surfaces are smooth and flat with maximum variation of 1/8 inch in 10 ft., and are ready to receive Work.
 - B. Beginning of installation means acceptance of existing substrate and site conditions.

3.2 PREPARATION GENERAL:

- A. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
- B. Apply, trowel, and float filler to leave a smooth, flat, hard surface.
- C. Prohibit traffic from area until filler is cured.
- D. Vacuum clean substrate.

3.3 PREPARATION ATHLETIC FLOORING:

- A. Prepare Substrates according to ASTM F710 including the following:
 - 1. For glue down tile:
 - a. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - b. Perform anhydrous calcium chloride test, ASTM F1869. Results must not exceed 5 lbs. Moisture Vapor Emission Rate per 1,000 sq. ft. in 24 hours.
 - c. Perform relative humidity test using in situ probes, ASTM F2170. Must not exceed 80%.
 - 2. A pH test for alkalinity must be conducted. Results should range between 7 and 9. If the test results are not within the acceptable range of 7 to 9, the installation must not proceed until the problem has been corrected.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.

3.4 INSTALLATION - FLOOR TILE:

- A. Install in accordance with manufacturers' instructions.
- B. Mix tile from container to ensure shade variations are consistent.
- C. Quarter turn tile per manufacturer's recommendations
- D. Spread only enough adhesive to permit installation of materials before initial set.

- E. Set flooring in place, press with heavy roller to attain full adhesion.
- F. Install tile to square grid pattern with all joints aligned.
- G. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.
- H. Install edge strips at unprotected or exposed edges, and where flooring terminates.
- I. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- J. Install feature strips, edge strips, and floor markings where required indicated. Fit joints tightly.

3.5 RESILIENT ATHLETIC FLOORING INSTALLATION:

- A. Comply with manufacturer's written instructions for installing resilient athletic flooring.
- B. Resilient Athletic Rubber Tile Flooring:
 - 1. Install with adhesive specified for the site conditions and follow adhesive label for proper use.
 - 2. Do not Quarter Turn tile.
 - 3. Roll the flooring in both directions using a 100 pound three-section roller.

3.6 INSTALLATION - BASE MATERIAL:

- A. Fit joints tight and vertical. Maintain minimum measurement of 18 inches between joints.
- B. Miter internal corners. At external corners, use premolded units. At exposed ends use premolded units.
- C. Install base on solid backing. Bond tight to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

3.7 CLEANING:

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Remove excess adhesive from floor, base, and wall surfaces without damage.
- C. Clean, seal, and apply protective polish to the floor and base surfaces in accordance with manufacturer's instructions for initial maintenance.
- D. A regular maintenance program must be started after the initial cleaning.

3.8 PROTECTION:

- A. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
 - 1. No traffic for 24 hours after installation.
 - 2. No heavy traffic, rolling loads, or furniture placement for 72 hours after installation.

END OF SECTION

SECTION 09685 CARPET TILE

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Tile carpeting.
- B. Edgings and Cap strips.

1.2 RELATED SECTIONS:

- A. Division 01: Administrative, procedural, and temporary work requirements.
- B. Section 03010 Maintenance of Concrete: For repair, resurfacing and cleaning of existing concrete surfaces.
- C. Section 09056 Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

1.3 REFERENCES

- A. ASTM D2859 Standard Test Method for Flammability of Finished Textile Floor Covering Materials.
- B. ASTM D4258 Standard Practice for Surface Cleaning Concrete for Coating.
- C. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. ASTM E648 Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
- E. ASTM E662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
- F. ASTM F710 Standard Practice for Preparing Concrete to Receive Resilient Flooring.
- G. ASTM F1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- H. ASTM F2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- I. Carpet and Rug Institute (CRI)
 - 1. 104 Standard for Installation Specification of Commercial Carpet Indoor Air Quality Testing ProgramNational Fire (NFPA)253 - Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.4 SUBMITTALS

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Submittals for Review:

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CARPET TILES

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- 1. Shop Drawings: Indicate carpet tile locations, dye lot limitations, direction of carpet tile in each room or area, and type and location of edgings.
- 2. Samples:
 - a. Carpet tile: 12 x 12 inch samples showing available colors.
 - b. Edgings: (4) inch long samples showing available colors.
 - c. Warranty: Sample warranty form.
- C. Quality Control Submittals:
 - 1. Certificates of Compliance: Certification from an independent testing laboratory that carpet tiles meet fire hazard classification requirements.

1.5 QUALITY ASSURANCE:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Installer Qualifications: Minimum Five (5) years documented experience in work of this Section.
- C. Fire Hazard Classification: Class I rated, tested to NFPA 253
- D. Fire Hazard Classification: Pass flammability requirements of ASTM D2859.
- E. Fire Hazard Classification: Maximum flame spread/smoke developed rating of 75/125, tested to ASTM E84.
- F. Fire Hazard Classification: Maximum smoke density rating of 450 tested to ASTM E662.
- G. Pre-Installation Conference:
 - 1. Convene at site 2 weeks prior to beginning work of this Section.
 - 2. Attendance: Architect, Contractor, Construction Manager, carpet tile installer, carpet tile manufacturer's representative, and related trades.
 - 3. Review and discuss: Contract Documents, carpet tile manufacturer's literature, project conditions, scheduling, protection after installation, and other matters affecting application.

1.6 PROJECT CONDITIONS:

- A. Do not begin installation until painting and finishing work have been completed.
- B. Environmental Requirements:
 - 1. Temperature of spaces and subfloor between 65 and 90 degrees F.
 - 2. Humidity in spaces to receive carpet tiles between 20 and 65 percent.

1.7 WARRANTIES

- A. Furnish manufacturer's 5 year warranty providing coverage against:
 - 1. Defective materials and workmanship.
 - 2. Excessive fading.
 - 3. Loss of static control.
 - 4. Edge raveling.
 - 5. Runs.
 - 6. Loss of tuft bind strength.
 - 7. Loss of face fiber.
 - 8. Excessive wear.

1.8 MAINTENANCE

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CARPET TILES

A. Extra Materials: One unopened carton of each tile.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS:
 - A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.
 - 1. Carpet Tiles:
 - a. Shaw. (www.shawcontract.com)
 - B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed. Submit as substitution according to Conditions of the Contract and Section 01 25 00.
 - 1. Interface, Inc. (www.interfaceinc.com)
 - 2. Mohawk International (www.mohawkinternational.com)
 - C. Substitutions: See Section 01630 Product Substitutions.

2.2 MATERIALS:

- A. Carpet Tiles:
 - 1. Source: Refer to Drawings by Shaw Contract Group.
 - 2. Class I.
 - 3. Pattern: Refer to Drawings.
 - 4. Color: Refer to Drawings.
 - 5. Construction: Multi-level pattern loop.
 - 6. Face yarn type: Nylon 6.
 - 7. Face yarn weight: 18 ounces per square yard.
 - 8. Backing: Primary: polyolefin composite. Secondary: ecoworx® tile.
 - 9. Total weight: 18 ounces per square yard.
 - 10. Size: 18 x 36 inches.
 - 11. Protective treatment: ssp®.

2.3 ACCESSORIES

- A. Adhesive:
 - 1. Waterproof, latex based cement formulated specifically for installing carpet tiles;
- C. Edgings: Preformed rubber, metal, or approved substitute, profile required to suit conditions, color to be selected from manufacturer's full color range or to match carpet tiles.
- D. Cap Strip: Preformed rubber; vinyl; or, prefinished metal; profile required to suit conditions, color to be selected from manufacturer's full color range or to match carpet tiles.
- E. Leveling Compound: Premixed, latex based.

PART 3 - EXECUTION

3.1 EXAMINATION:

CARPET TILES

- A. Verify that concrete floors have cured a minimum 28 days and do not exhibit negative alkalinity, carbonization, or dusting.
- 3.2 PREPARATION:
 - A. Clean substrate to ASTM D4258.
 - B. Clean substrate; remove loose and foreign matter that could impede adhesion or performance of flooring.
 - C. Fill cracks, voids, and depressions with leveling compound.
 - D. Grind ridges and high spots smooth.
 - E. Test Substrate:
 - 1. Moisture vapor: Test to ASTM F1869; do not install carpet tiles until moisture emission level is 3 pounds per 1000 square feet or less.
 - 2. Humidity: Test to ASTM F2170; do not install carpet tiles until relative humidity is 75 percent or less.
 - 3. Alkalinity: Test to ASTM F710; do not install carpet tiles unless pH is 9 or less.

3.3 INSTALLATION OF CARPET TILES:

- A. Install in accordance with CRI 104.
- B. Install carpet tile and adhesive in accordance with manufacturers' instructions.
- C. Blend carpet tiles from different cartons to ensure minimal variation in color match.
- D. Lay out each room or area to minimize tiles less than one half size.
- E. Cut tile clean. Fit tiles tight to intersection with vertical surfaces without gaps.
- F. Pattern: Refer to Drawings.1. Locate change of color or pattern between rooms under door centerline.
- G. Fully adhere carpet tiles to substrate.
 - 1. Adhere tiles in one row in each direction at 30 feet on center maximum. Adhere perimeter and cut tiles. Lay remaining tiles loose.
- H. Place carpet tile dry over substrate.
- I. Bind cut edges where not concealed by edge strips.

3.4 INSTALLATION OF EDGINGS:

- A. Install strips where carpet tiles abut dissimilar flooring materials; secure to subfloor.
- B. Center strips under doors where carpet tiles terminate at door openings.
- C. Install in longest practical lengths; butt ends tight.
- D. Scribe to abutting surfaces.
- 3.5 CLEANING:

CARPET TILES

- A. Clean spots as recommended by carpet tile manufacturer.
- B. Cut off loose threads flush with top surface.
- C. Clean with commercial vacuum cleaner.

END OF SECTION

CARPET TILES

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SECTION 09900

PAINTING AND COATINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Surface preparation and application of paints and coatings
- B. Surface finish schedule.
- C. Field application of paints, stains, varnishes, and other coatings.
- D. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Exposed surfaces of steel lintels and ledge angles.
 - 3. Prime surfaces to receive wall coverings.
 - 4. Mechanical and Electrical:
 - a. In finished areas, paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - b. In finished areas, paint shop-primed items.
 - c. On the roof and outdoors, paint all equipment that is exposed to weather or to view, including that which is factory-finished.
 - d. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
 - e. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
- E. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Floors, unless specifically so indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.2 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
 - 1. Provide data on all finishing products and special coatings, including VOC content and; a. Product characteristics.
 - b. Surface preparation instructions and recommendations.
 - c. Primer requirements and finish specification.
 - d. Storage and handling requirements and recommendations.

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PAINTING AND COATINGS

- Application methods. e.
- Cleanup Information. f.
- 2. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
- 3. MPI product number (e.g. MPI #47).
- 4. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- 5. If proposal of substitutions is allowed under submittal procedures, explanation of all substitutions proposed.
- Provide product equivalency table. 6.
- C. Samples: Submit six (6) paper "draw down" samples of each color selected, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified, or six (6) manufacturer's paint charts with each selected color clearly identified.
 - Where sheen is specified, submit samples in only that sheen. 1.
 - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.
- D. Samples shall be submitted at least 30 days prior to the start of painting work. Label and identify each sample as to location and application. Upon submittal of color samples, minor variations or changes in color selection may be requested by the Architect and new samples ordered, until final color approval.
- E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and coated surfaces, and color samples of each color and finish used.
 - 1. Coating Maintenance Manual: upon conclusion of the project, the Contractor or paint manufacture/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams "Custodian Project Color and Product Information" report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - See Section 01600 Product Requirements, for additional provisions. 1
 - 2. Provide all broken lot containers of paint to Owner.
 - 3. Provide 5 gallons of each trim color in fresh, unopened containers.
 - 4. Provide 5 gallons of each wall color in fresh, unopened containers.
 - 5. Provide paint color chart reflecting brands, all colors and mixing formulas
 - Extra Paint and Coatings: 1 gallon of each color; store where directed. 6.
 - 7. Label each container with color, type, texture, room locations, and shelf life in addition to the manufacturer's label.

QUALITY ASSURANCE: 1.3

- Α. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with ten (10) years experience.
- Β. Applicator: Company specializing in commercial painting and finishing with five (5) years documented experience.
- C. Standards: Preparation, application and workmanship shall be in accordance with manufacturer's recommendations and applicable provisions of the following: 1.
 - Painting and Decorating Contractors of America (PDCA) "Painting Specification Manual"

PAINTING AND COATINGS
and "Standards".

- a. PDCA P1-13: Touch-Up Painting And Damage Repair: Financial Responsibility and Definition of a Properly Painted Surface.
- b. PDCA P2-13: Third Party Inspections: Qualifications, Responsibilities, and Procedures.
- c. PDCA P3-13: Designation of Paint Color.
- d. PDCA P4-13: Responsibility for Inspection and Acceptance of Surfaces Prior to Painting and Decorating.
- e. PDCA P5-13: Benchmark Sample Procedures for Paint and Other Decorative Coating Systems.
- 2. Gypsum Association GA-232-04: "Painting New Gypsum Board".
- 1.4 REGULATORY REQUIREMENTS:
 - A. Conform to applicable code for flame/fuel/smoke rating requirements for finishes.
- 1.5 DELIVERY, STORAGE AND HANDLING:
 - A. Deliver products to site in sealed and labeled containers; inspect to verify acceptance.
 - B. Container labeling to include manufacturer's name, type of paint, brand name, drying time, cleanup, color designation, and instructions for mixing and reducing.
 - C. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in well ventilated area, unless required otherwise by manufacturer's instructions.
 - D. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.6 ENVIRONMENTAL REQUIREMENTS:

- A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.
- B. Do not apply exterior coatings in damp weather or when relative humidity is above 50 percent, unless required otherwise by manufacturer's instructions.
- C. Minimum application temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Provide lighting level of 80 ft. candles measured mid-height at substrate surface.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – PAINT:

- A. Furnish products of one of the following manufacturers, except as otherwise approved by Architect, subject to compliance with specification requirements.
 - 1. Sherwin Williams: www.sherwin-williams.com.
 - 2. Dunn-Edwards Corporation: www.dunnedwards.com.
 - 3. Benjamin Moore: www.benjaminmoore.com.
 - 4. Behr Process Corporation: www.behr.com.
 - 5. Tnemec (High Performance Finish Systems Only) www.tnemec.com.
- B. Substitutions: See Section 01630 Product Substitutions.

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2.2 MATERIALS:

- A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
- B. Coatings: Good flow and brushing properties; capable of drying or curing free of streaks or sags.
- C. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.
- D. All paint products shall contain no mercury compounds.
- E. Provide materials in accordance with the Schedule of Paint Products at the end of this Section as applicable to project. Contractor shall provide either waterborne or solventborne products at contractor's option and as follows:
 - 1. Waterborne:
 - a. Provide where low odor and fast dry are desired.
 - b. Non-blocking materials shall be used for doors, door jambs, railings and other locations subject to handling, or where surfaces will come into contact with other painted surfaces or belongings.
 - 2. Solventborne:
 - a. Provide where harder finish is required (such as "wet" areas) and odor will not create problems with occupants.
 - b. These products shall not be used where color retention is a concern. Verify with Architect.
 - 3. Materials used shall comply with applicable Federal and local air pollution regulations, lead content laws, and current VOC requirements. If products listed in Schedule of Paint Products located at the end of this Section are not in compliance with regulations, laws, or requirements, Contractor shall notify Architect and shall provide information regarding substitute products.
- F. Basic painting materials such as linseed oil, shellac, turpentine, thinners, driers, and other similar products, shall be of highest quality, made by reputable, recognized manufacturers, and have identifying labels on containers. Paint materials shall be factory fresh.
- G. Alternate materials submitted for prior approval shall have qualities and materials equal to the other listed manufacturer's scheduled, top of the line, first quality products. Materials selected for coating systems for each type of surface shall be the products of a single manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Verify that substrate conditions are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

3.2 PREPARATION:

- A. General:
 - 1. Surfaces requiring painting or finishing shall be thoroughly dry and cured, free of dirt, dust, rust, stains, scale, mildew, wax, grease, oil, deteriorated substrates, bond-breakers, efflorescence and other foreign matter detrimental to the coating's adhesion

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and performance. Repair voids, cracks, nicks and other surface defects with appropriate patching material. Finish flush with surrounding surfaces and match adjacent finish texture.

- 2. Spot prime marred or damaged shop coats on metal surfaces with appropriate metal primer.
- 3. Determine moisture content of plaster, stucco, cementitious materials, wood, and other moisture-holding materials by use of a reliable electronic moisture meter.
- 4. Determine alkalinity of plaster, stucco and other cementitious materials by performing appropriate tests.
- 5. Do not paint surfaces where moisture content or alkalinity exceeds that which is allowed by paint manufacturer.

3.3 PREPARATION - PREVIOUSLY PAINTED SURFACES:

- A. Comply with all requirements for preparation for new construction as listed below and the following requirements for existing, previously painted surfaces:
- B. Surfaces which cannot be prepared or painted as specified shall be immediately brought to the attention of the Architect in writing
- C. Clean all surfaces free of all dirt, dust, loose and unsound paint coatings and other foreign matter by hydrowash method with additional scraping and sanding as required. Provide a clean, sound surface for the new paint coatings.
- D. Repair cracks and voids in plaster surfaces.
- E. Prior to surface preparation and painting operations, mask, remove or otherwise adequately protect all hardware, accessories, machined surfaces, plates, fire sprinkler heads, lighting fixtures and similar items in contact with painted surfaces but not scheduled to receive paint.
- F. Spot prime exposed nails and other metals which are to be painted with emulsion paints, using a primer recommended by the manufacturer of the coating system.
- G. Clean all ferrous metal surfaces until they are completely free from dirt, oil and grease. After cleaning, apply one coat of the specified primer the same day to all ferrous metal surfaces scheduled to be painted.
- H. Clean all galvanized metal surfaces thoroughly with solvent until they are completely free from dirt, oil and grease. Then treat thoroughly with phosphoric acid etch. Remove all excess etching solution and allow to dry completely before application of paint.
- I. Remove efflorescence by wire brushing, power brushing or washing. Thoroughly rinse surfaces wire brushed. After removal of efflorescence, wash the surface with a commercially available cleaner acceptable to the manufacturer of the substrate.
- J. Remove existing wallcovering and wash the surface to remove paste residue. Seal surface before making any surface repairs.
- K. Dull and roughen glossy surfaces to obtain proper adhesion by either sanding, washing with a tri-sodium phosphate solution, or treating with a liquid deglossing compound.
- L. Overlap and feather edge spot-primed areas

3.4 PREPARATION - NEW CONSTRUCTION:

A. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or

finishing.

- B. Correct minor defects and clean surfaces which affect work of this Section.
- C. Shellac and seal marks which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- F. Gypsum Board Surfaces: Latex fill minor defects. Spot prime defects after repair.
- G. Galvanized Surfaces: Remove surface contamination and oils, wash with solvent, apply coat of etching primer.
- H. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- I. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- J. Wood:
 - 1. Sandpaper to smooth and even surface and then dust off. After primer or stain coat has been applied, thoroughly fill nail holes and other surface imperfections with putty tinted with primer or stain to match wood color. Sand woodwork between coats to a smooth surface. Cover knots and sap streaks with a thin coat of shellac, or seal with a suitable stain blocking sealer.
 - 2. Finish door and window edges after final fitting. Finish interior of cabinets in the same manner as the exterior unless otherwise specified. Seal interior of drawers unless otherwise specified.
 - 3. Backpriming:
 - a. Backprime exterior woodwork, which is to receive paint finish, with exterior primer paint.
 - b. Backprime interior woodwork, which is to receive paint or enamel finish, with enamel undercoater paint.
 - c. Backprime interior and exterior woodwork, which is to receive stain and/or varnish finish with VOC compliant varnish acceptable to the Architect.
 - d. Back-prime wood trim before installation.
 - 4. Where existing stained surfaces are indicated to be coated with a transparent stain, test apply stain to small area where directed by Architect and obtain Architects approval of color.
- K. Steel and Iron:
 - 1. Remove grease, oil, mill scale, rust and rust scale and touch-up chipped or abraded places on items that have been shop coated. Remove and reprime incompatible or damaged shop applied primers. Comply with the Steel Structures Painting Council's (SSPC) recommendations for cleaning of uncoated steel and iron surfaces.
 - 2. When area will be exposed to view, sandpaper the entire primed area smooth, feather the edge of surrounding undamaged prime coat and spot prime in a manner to eliminate evidence of repair.

- 3. Where steel or iron at existing Work have a heavy coating of scale, remove by sand blasting, sanding, descaling, grinding or wire brushing, as necessary, to produce a satisfactory surface for painting.
- L. Galvanized Metal and Aluminum:
 - 1. Thoroughly clean by wiping surfaces with a non-hydrocarbon solvent that will not leave an oily residue. Apply surface conditioner or vinyl-wash pretreatment as required for proper adhesion if required by paint manufacturer. Prime galvanized metal with galvanized iron primer as recommended by paint manufacturer. A test sample of the complete painting system should be applied and checked for adhesion before final painting begins.
 - 2. Clean visible portions of throats of galvanized steel ductwork with solvent; wipe dry with clean rags and paint flat black.
- M. Concrete:
 - 1. The method of surface preparation shall be at Contractor's discretion, provided the results are satisfactory to the Architect, and the method is in compliance with applicable codes and requirements.
 - 2. Clean and prepare surfaces of tilt-up precast concrete wall panels to be painted by power washing surface to remove all efflorescence, chalk, dust, dirt, grease, oils and release agents.
 - 3. Repair surfaces to be painted prior to application of prime and finish coat(s). Apply a tinted primer to the substrate to help identify surface imperfections. After the primer has thoroughly dried, patch, fill and repair surface imperfections to match and flush-out with adjacent finish texture and profile.
 - 4. Before first paint coat is applied, spot prime nails and other exposed metal occurring in the surfaces with a rust inhibitive primer as recommended by paint manufacturer.
- N. Plaster and Gypsum Board Surfaces:
 - 1. Fill cracks, holes or imperfections with compatible patching material and smooth off to match adjoining surfaces. Before painting, surfaces shall be first tested for dryness with a moisture testing device.
 - 2. Apply no paint or sealer on gypsum board or plaster when the moisture content exceeds 8 percent. Test sufficient areas in each space and as often as necessary to determine if the surface has the proper moisture content for painting. If the moisture content is between 8 percent and 12 percent, prime with alkali resistant primer.
 - 3. If 8 percent or less, prime with specified primer. Remove the dry salt deposits from plaster surfaces by brushing with a stiff brush before painting.
- O. Acoustical Surfaces (Lay-in acoustical ceiling panels, acoustical wall panels, etc.):
 - 1. Thoroughly vacuum clean surfaces to remove dust and debris from acoustical surface pores. Use a soft brush attachment that will not damage or loosen acoustical surface.
 - 2. Seal surface stains with a suitable stain blocking sealer that will not fill pores of acoustical surface.
 - 3. Apply no paint or sealer on gypsum board or plaster when the moisture content exceeds 8 percent. Test sufficient areas in each space and as often as necessary to determine if the surface has the proper moisture content for painting. If the moisture content is between 8 percent and 12 percent, prime with alkali resistant primer.
- P. Clean surfaces thoroughly and correct defects prior to coating application.
- Q. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- R. Remove or repair existing coatings that exhibit surface defects.

- S. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- T. Seal surfaces that might cause bleed through or staining of topcoat.
- U. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- V. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- W. Gypsum Board Surfaces to be painted: Fill minor defects with filler compound. Spot prime defects after repair.
- X. Plaster Surfaces to be painted: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- Y. Asphalt, Creosote, or Bituminous Surfaces to be painted: Remove foreign particles to permit adhesion of finishing materials. Apply latex based sealer or primer.
- Z. Insulated Coverings to be painted: Remove dirt, grease, and oil from canvas and cotton.
- AA. Concrete Floors and Traffic Surfaces to be painted: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- BB. Aluminum Surfaces to be painted: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- CC. Galvanized Surfaces to be painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- DD. Corroded Steel and Iron Surfaces to be painted: Prepare using at least SSPC-SP 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).
- EE. Uncorroded Uncoated Steel and Iron Surfaces to be painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- FF. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
- GG. Interior Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- HH. Interior Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

- II. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.
- JJ. Exterior Wood to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior calking compound after sealer has been applied. Prime concealed surfaces.
- KK. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
- LL. Metal Doors to be painted: Prime metal door top and bottom edge surfaces.

3.5 APPLICATION:

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish.
- D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- E. Sand lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Allow applied coat to dry before next coat is applied.
- H. The number of coats scheduled is the minimum number of coats required. Additional coat(s) shall be applied, at no additional cost to the Owner, to completely hide base material, provide uniform color and to produce satisfactory finish results.
- I. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- J. Prime back surfaces of interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.
- K. Apply coatings without thinning except as specifically required by label directions, or required by these specifications. In such cases, thinning shall be the minimum reduction permitted.
- L. Priming will not be required on items delivered with prime or shop coats, unless otherwise specified. Touch up prime coats applied by others as required to ensure an even primed surface before applying finish coat.
- M. Block Fillers: Provide level of block fill as scheduled to conform with the following:
 - 1. Level 1 Regular Fill: Minimum block fill, reduces irregularity in masonry profile. One coat, spray applied.
 - 2. Level 2 Medium Full Fill: Masonry profile slightly reduced. One coat, spray applied and back-rolled.
 - 3. Level 3 Full Fill: Minimum block fill required for semi-gloss and gloss finishes. Use where conformance with health regulations is required. Number of coats as required to conceal most of masonry texture, spray applied and back-rolled.
 - 4. Level 4 High Density Fill: Minimum of three coats. 1st coat massaged and forced into

masonry texture to assure uniform high density. 2nd coat, with build sufficient to fully conceal masonry texture and joints. Additional coats as required to level. Spray apply coats, back-roll and squeegee final coat. Add sand to final coat to achieve light sand texture where indicated.

- N. Paint exposed surfaces of every member; paint items inaccessible after installation before installation, if required to be painted. Edges, tops and bottoms of wood doors shall be sealed and finished with the same finish as the door faces, to meet door manufacturer's warranty requirements. Verify edge color with Architect as different colors may be selected for each face.
- O. Paint items fitted with finish hardware after hardware has been temporarily removed.
- P. Heating and other equipment on or adjacent to walls or surfaces scheduled for painting, shall be disconnected, using workmen skilled in appropriate trades and moved temporarily to permit painting of surface. Following completion of painting, replace and reconnect items.
- Q. Brush, wipe or roll stain in 2 coat application. Avoid lap marks by maintaining "wet-edge" continually being merged with existing liquid coverage and stop only at natural edges, turns and breaking places.
- R. Do not paint over Underwriters' Laboratory labels, fusible links, exposed sprinkler heads and other similar items.
- S. Paint surface of walls which will be concealed by cabinets and other wall mounted items.
- T. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.
- U. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- V. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- W. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- 3.6 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT:
 - A. Paint shop primed equipment and shop prefinished items.
 - B. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
 - C. Spray paint prime coated (not pre-finished) grilles and registers with enamel or lacquer to match walls and ceilings. Paint materials shall not sag, run or bind movable parts of grilles, registers, louvers, baffles and other similar items.
 - 1. Throats of ducts shall be given one coat of flat black paint, wherever visibility of the interior of the duct is allowed through registers or other similar items. At fiber lined duct, use black latex paint.
 - 2. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint, to limit of sight line. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
 - 3. Examine the Mechanical and Electrical Drawings and Specifications to determine the amount of exposed work to be painted.

- D. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports except where items are prefinished.
- E. Replace identification markings on mechanical or electrical equipment when painted accidently.
- F. Paint exposed unfinished fixtures, metal ducts, switch boxes, control panels, devices, starters, junction boxes, vents, drains, and other similar items, as directed by Architect
- G. Color code equipment, piping, conduit, and exposed ductwork in accordance with requirements indicated. Color band and identify with flow arrows, names and numbering.
- H. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.
- I. Exterior and interior exposed water, gas, waste piping, sprinkler piping, conduit, lighting and electrical panels, telephone terminal boxes, galvanized ducts and insulated ducts, shall be painted in areas other than mechanical rooms, unless otherwise scheduled.

3.7 FIELD QUALITY CONTROL:

- A. See Section 01400 Quality Requirements, for general requirements for field inspection.
- B. Painted exterior and interior surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent to the Architect:
 - 1. Brush / roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
 - 2. Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
 - 3. Damage due to touching before paint is sufficiently dry or any other contributory cause.
 - 4. Damage due to application on moist surfaces or caused by inadequate protection from the weather.
 - 5. Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).
- C. Painted surfaces shall be considered unacceptable if any of the following are evident under natural lighting source for exterior surfaces and final lighting source (including daylight) for interior surfaces:
 - 1. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 1000 mm (39").
 - 2. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 1000 mm (39").
 - 3. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.
 - 4. When the final coat on any surface exhibits a lack of uniformity of color, sheen, texture, and hiding across full surface area.
- D. Painted surfaces rejected by the Architect shall be made good at the expense of the Contractor. Small affected areas may be touched up; large affected areas or areas without sufficient dry film thickness of paint shall be repainted. Runs, sags of damaged paint shall be removed by scraper or by sanding prior to application of paint.
- E. Paint System Manufacturer's Technical Representative
 - 1. The paint system manufacturer's technical representative shall be present at the jobsite for the pre-painting conference and for the first day of paint application, and shall be available for consultation for the full project duration.

- F. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
- 3.8 CLEANING:
 - A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.
 - B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
 - C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.9 PROTECTION:

- A. Protect elements surrounding the work of this Section from damage or disfiguration.
- B. Repair damage to other surfaces caused by work of this Section.
- C. Furnish drop cloths, shields, and protective methods to prevent disfiguring other surfaces.
- D. Remove empty paint containers from site.

3.10 SCHEDULE - INTERIOR SURFACES:

- A. Interior Wood Painted:
 - 1. First Coat: Enamel undercoat
 - 2. Second Coat: Semi-Gloss Acrylic Enamel
 - 3. Third Coat: Semi-Gloss Acrylic Enamel
- B. Interior Wood Transparent
 - 1. First Coat: Lacquer Wood Stain
 - 2. Second Coat: Sanding Sealer
 - 3. Third Coat: Clear Satin Lacquer
 - 4. Fourth Coat: Clear Satin Lacquer
- C. Interior Gypsum Board:
 - 1. First Coat: Acry-prime Acrylic
 - 2. Second Coat: Acrylic Semi-Gloss Enamel
 - 3. Third Coat: Acrylic Semi-Gloss Enamel
- D. Interior Gypsum Board Ceilings and Soffits (None wet locations):
 - 1. First Coat: Acry-prime Acrylic
 - 2. Second Coat: Acrylic Flat Enamel
 - 3. Third Coat: Acrylic Flat Enamel
- E. Interior Ferrous Metals:
 - 1. First Coat: Epoxy based metal Primer
 - 2. Second Coat: Water Based Semi-Gloss Enamel
 - 3. Third Coat: Water Based Semi-Gloss Enamel
- F. Interior Galvanized Metals:
 - 1. First Coat: Epoxy based metal primer
 - 2. Second Coat: Water Based Semi-Glass Enamel
 - 3. Third Coat: Water Based Semi-Gloss Enamel

- G.
- Interior Hollow Metal (Ferrous and Galvanized)
 1. First Coat: Factory primed finish or epoxy based metal primer
 2. Second Coat: Water Based Semi-Glass Enamel

 - Third Coat: Water Based Semi-Gloss Enamel 3.

END OF SECTION

VISUAL DISPLAY SURFACES

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Markerboards.

1.2 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- D. Samples: Submit five (5) samples of tackboard finish and bulletin board back panel finish.

1.3 PROJECT CONDITIONS:

- A. Environmental Limitations:
- B. Do not deliver or install visual display surfaces until spaces are enclosed and weathertight.
- C. Ensure wet work in spaces is complete and dry, work above ceilings is complete.
- D. Ensure temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.4 WARRANTY:

- A. Manufacturer's standard warranty to include manufacturer agreement to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within 50 years of date of Substantial Completion.
- B. Failures include, but are not limited to, the following:
 - 1. Surfaces lose original writing and erasing qualities.
 - 2. Writing surfaces becoming slick and shiny
 - 3. Surfaces exhibit crazing, cracking, or flaking.

PART 2 - PRODUCTS

- 2.1 ACCEPTABLE MANUFACTURERS:
 - A. Claridge: <u>www.claridgeproducts.com</u>.
 - B. Nelson Adams/NACO: <u>www.nelsonadamsnaco.com</u>.
 - C. Shanahan's Ltd.
 - D. Platinum Visual System

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VISUAL DISPLAY SURFACES

E. Substitutions: See Section 01630 - Product Substitutions.

2.2 MATERIALS:

- A. Steel Sheet: ASTM A424, Type I, commercial quality.
- B. Aluminum Extrusions: ANSI/ASTM B221.
- C. Cork: Fine grain natural cork, homogeneous composition.
- D. Particle Board: ANSI A208.1; wood shavings set with waterproof resin binder, sanded faces.
- E. MDF Board: ANSI A-208.2
- F. Adhesives: Type recommended by manufacturer.

2.3 MARKERBOARDS:

- A. Boards: ADP Lemco, Model W202 porcelain enamel over steel markerboard or equivalent.
- B. Face:
 - 1. Low gloss, dry--erase white porcelain over steel board.
 - 2. 28 gauge sheet steel face pressure laminated to core.
 - 3. Fasten to trim from back on 16 inch centers.
- C. Core: 1/2 inch MDF with .005 aluminum foil backing core.
- D. Frame:
 - 1. Extruded aluminum factory fabricated frame with continuous marker trough and map rail and matching accessories.
 - 2. Clear anodized aluminum finish.
 - 3. Marker Trough: 2-5/8 inch blade type aluminum marker trough, continuous full length of board with 1 inch radius ends at each corner.
 - 4. Map rail: 1 inch high, continuous full length of board, with 3/4 inch X 1/4 inch natural cork insert and endstops.
 - 5. Two (2) map hooks with hook and metal spring clip per 4 feet of board length.
- E. Mounting: Manufacturer's standard Z-bar or clip brackets for concealed, mechanical mounting.
- F. Size: Provide 4 foot high and in sizes shown on drawings. Provide continuous boards up to 12 feet in length. Splicing allowed for lengths over 12 feet.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display surfaces.
- 3.2 INSTALLATION, GENERAL:

VISUAL DISPLAY SURFACES

- A. Install markerboards, tackboards, in accordance with manufacturer's instructions.
- B. Provide for manufacturer's standard concealed mechanical attachment.
- C. Establish top of perimeter frame at same elevation as top of adjacent door frames approximately 86 inches above finished floor unless noted otherwise.
- D. Secure units level and plumb.

3.3 CLEANING AND PROTECTION:

- A. Clean visual display surfaces according to manufacturer's written instructions.
- B. Attach one cleaning label to visual display surface in each room.
- C. Touch up factory-applied finishes to restore damaged or soiled areas.
- D. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION

VISUAL DISPLAY SURFACES

SECTION 10434 SIGNAGE

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Room and door signs
 - B. Interior directional and informational signs
 - C. Building identification signs
 - D. Cast Plaques
 - E. Lettering

1.2 RELATED REQUIREMENTS:

- A. Section 15190 Mechanical Identification.
- B. Section 16075 Identification for Electrical Systems.

1.3 REFERENCE STANDARDS:

- A. 36 CFR 1191 Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ICC A117.1 Accessible and Usable Buildings and Facilities; International Code Council; 2009 (ANSI).
- D. ASTM E2072 Standard Specification for Photoluminescent (Phosphorescent) Safety Markings; 2014.
- E. ATBCB ADAAG Americans with Disabilities Act Accessibility Guidelines; 2004

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts and colors.
 - 1. When room number to appear on signs differ from those on the drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.

- D. Samples: Submit one sample of each room sign type, of size similar to that required for project, illustrating sign style, font and method of attachment; include sign insert features.
- E. Selection Samples: Submit two sets of color selection chips.
- F. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

1.5 QUALITY ASSURANCE:

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum ten (10) years of documented experience.
- B. Any (substitution) material submitted as equal to the specified material must be accompanied by a notarized report signed and sealed by a professional engineer licensed in the state in which the installation is to take place. This report shall show that the submitted equal meets the criteria in this specification. Substitution requests submitted without notarized report will be rejected for non-conformance.
- C. Signage System Manufacturer will issue a 7 year Limited Warranty on all products.
- 1.6 DELIVERY, STORAGE AND HANDLING:
 - A. Package signs as required to prevent damage before installation.
 - B. Package room and door signs in sequential order of installation, labeled by floor or building.
 - C. Store tape adhesive at normal room temperature.

1.7 FIELD CONDITIONS:

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS:
 - A. Signs:
 - 1. Best Sign Systems, Inc.: www.bestsigns.com.
 - 2. Inpro; Aspen produced in one piece photopolymer media: www.inprocorp.com.
 - 3. Seton Identification Products: www.seton.com/aec.
 - B. Substitutions: See Section 01630 Product Substitutions.

2.2 SIGNAGE TYPES::

- A. Accessibility Compliance: All signs are required to comply with ADAAG and ANSI/ICC A 117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.

- 1. Sign Type: Flat signs with engraved panel media as specified.
- 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
- 3. Character Height: 1 inch.
- 4. Sign Height: 2 inches, unless otherwise indicated.
- 5. Office Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section for replaceable occupant name.
- 6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
- 7. Service Rooms: Identify with room names and numbers to be determined later, not those shown on the drawings.
- 8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Interior Directional and Informational Signs
 - 1. Type: Architectural standard to match room and door signs.
 - 2. Size: As indicated in drawings.
 - 3. Text: Wording of signs is scheduled on the Drawings. 4.
 - 4. Where suspended, ceiling mounted, or projecting from wall signs are indicated, provide two-sided signs with same information on both sides.
- D. Exterior Room and Directional Signage:
 - 1. Type: Aluminum to meet code
 - 2. Size: As indicated in drawings.
 - 3. Text: Wording of signs is scheduled on the Drawings.
- E. Fire Extinguisher Cabinets: Cabinets and enclosed compartments used to house portable fire extinguishers shall be clearly marked with the words FIRE EXTINGUISHER in letters at least 2 inches (51 mm) high.
 - 1. Identify extinguishers and cabinets with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface

2.3 DIMENSIONAL LETTERS (BUILDING IDENTIFICATION):

- A. Building Identification and Monument Signs:
- B. Monument Insignia Sign: Furnished by Owner and installed by contractor.

2.4 ACCESSORIES:

- A. Concealed Screws: Stainless Steel, galvanized steel, chrome plated or other non-corroding metal.
- B. Construction Adhesive: GE Silicone or other commercial grade adhesive as required.
- C. Tape Adhesive: Double-sided tape, permanent adhesive.
- D. Room Sign Backer Plate: Same as room sign construction; located at glass sidelights location; or as required.

PART 3 - EXECUTION

3.1 EXAMINATION:

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A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Install interior signs with both construction adhesive and tape adhesive.
- D. Install room and door signs, scheduled at exterior locations, with stainless steel pan head screws per approved shop drawings.
- E. Locate signs where indicated:
 - 1. Room Signs: Locate on wall at latch side of door with centerline of sign at 60 inches above finished floor.
 - 2. If no location is indicated, obtain Owner's instructions.
- F. Protect from damage until Substantial Completion; repair or replace damaged items.

3.3 SCHEDULE

A. Refer to Drawings

END OF SECTION

SOLID SURFACE TOILET PARTITIONS

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Solid plastic toilet compartments and urinal screens.

1.2 RELATED REQUIREMENTS

- A. Section 05500 Metal Fabrications: Concealed steel support members.
- B. Section 09260 Gypsum Board Assemblies: Sheet Metal Backing.
- C. Section 10800 Toilet Room Accessories.

1.3 REFERENCE STANDARDS:

- A. ANSI/ICC A117.1 American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- B. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- C. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.
- D. NFPA 286 Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.5 SUBMITTALS

- A. See Section 01330 Submittal procedures, for submittal Requirements
- B. Shop Drawings: Submit manufacturer's shop drawings for each product specified, including the following:
 - 1. Indicate partition plan, elevation views, dimensions, details of wall supports, door swings and attachment to adjacent construction.
 - 2. Show anchorage locations and accessory items.
- C. Product Data: Provide data on panel construction, hardware, and accessories.
 - 1. Provide copies of NFPA 286 room-corner test reports from an accredited laboratory showing that the partitions meet these requirements.
- D. Samples: Submit 4 samples of partition panels, 6" x 6" in size illustrating panel finish, color, and sheen.

SOLID SURFACE TOILET PARTITIONS

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.6 QUALITY ASSURANCE

- Α. Manufacturer: Provide products manufactured by a company with a minimum of 10 years successful experience manufacturing similar products.
- Β. Single Source Requirements: To the greatest extent possible provide products from a single manufacturer.
- C. Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to ADA and ICC/ANSI A117.1 requirements as applicable.

1.7 DELIVERY, STORAGE, AND HANDLING

Α. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations. Protect from damage.

1.8 WARRANTY

- Α. See Section 01770 - Closeout Procedures for additional warranty requirements.
- Β. Manufacturer's Warranty: Manufacturer's standard 15 year limited warranty for panels, doors. and stiles against breakage, corrosion, delamination, and defects in factory workmanship. Manufacturer's standard 1 year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- Α. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect. Approved manufacturers: 1.
 - Scranton Products (Santana/Comtec/Capital); Product Hiney Hiders: a. www.scrantonproducts.com.
- Β. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed, submit as substitution according to Conditions of the Contract and Division 1 Sections.
- C. Substitutions: See Section 01630 - Product Substitutions.
- 2.2 SOLID PLASTIC TOILET COMPARTMENTS:
 - Α. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), floor-mounted unbraced.
 - Color: Refer to Drawings and Material Finish Schedules or as selected by Architect. 1.
 - Β. Doors Dimensions:
 - Thickness: 1 inch. 1.

- 2. Width: 24 inch.
- 3. Width for Handicapped Use: 36 inch, out-swinging.
- 4. Height: 60 inch. Top at 72" and bottom at 12" above finish floor.
- C. Panel Dimensions:
 - 1. Thickness: 1 inch.
 - 2. Height: 84 inch.
 - 3. Depth: As indicated on Drawings
 - 4. Height: 60 inch. Top at 72" and bottom at 12" above finish floor.
- D. Pilasters:
 - 1. Thickness: 1 1/4" inch.
 - 2. Width: As required to fit space; minimum 3 inch.
- E. Urinal Screens: Without doors; to match compartments; mounted to wall with two panel brackets.
 - 1. Depth: 18".
 - 2. Height: Top at 60". (1524 mm) and bottom at 12" (304 mm) above finished floor.
- 2.3 ACCESSORIES:
 - A. Pilaster Shoes: Formed ASTM A666, Type 304 stainless steel with No. 4 finish, 3 in high, concealing floor fastenings.
 - 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
 - B. Head Rails: Hollow anodized aluminum, 1 x 1-1/2 inch size, with anti-grip profile and cast socket wall brackets.
 - C. Pilaster Brackets: Satin stainless steel.
 - D. Wall Brackets: Continuous type, satin stainless steel.
 - E. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
 - 1. For attaching panels and pilasters to brackets: Through-bolts and nuts; tamper proof.
 - F. Hardware Set Standard:
 - 1. Brackets: Type 304 cast stainless steel pivot hinge with Number 4 satin finish hardware.
 - 2. Hinges: Heavy duty cast stainless steel, Type 304 with Number 4 finish; two per door.
 - a. Top Hinge: Opposing nylon gravity-acting cam allowing door to be set in various positions.
 - b. Bottom Hinge: Free swinging.
 - c. Emergency access feature for outside access.
 - 3. Latch and Keeper: Type 304 cast stainless steel with Number 4 finish; slide latch with combination stop and emergency release feature.
 - 4. Coat Hook: Type 304 cast stainless steel with Number 4 finish; combination hook and bumper on inswinging doors.
 - 5. Door Pull: Type 304 cast stainless steel with Number 4 finish.
 - 6. Exposed Fasteners: Chrome plated brass or stainless steel.
 - G. Hardware: Polished stainless steel:
 - 1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
 - 2. Nylon bearings.
 - 3. Door Latch: Slide type with exterior emergency access feature.
 - 4. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.

SOLID SURFACE TOILET PARTITIONS

- 5. Coat hook with rubber bumper; one per compartment, mounted on door.
- 6. Provide door pull for outswinging doors.

PART 3 - EXECUTION

- 3.1 EXAMINATION:
 - A. Verify that field measurements are as indicated.
 - B. Verify correct spacing of and between plumbing fixtures.
 - C. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION:

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.3 TOLERANCES:

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.4 ADJUSTING:

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

WALL AND CORNER PROTECTION

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Wall mounted corner guards.

1.2 SUBMITTALS:

- A. Product Data: Provide specifications for each system component and installation accessory required, including installation methods for each type of substrate.
- B. Shop Drawings: Show locations, extent and installation details of all products.
- C. Samples: Submit six (6) samples of each product specified for verification of color, texture, pattern and thickness:
- D. Sample of each product specified.
- E. Maintenance Data: Submit for wall protection system components for inclusion in the operating and maintenance manuals.

1.3 QUALITY ASSURANCE:

- A. Fire Performance Characteristics: Provide wall protection system components with UL label indicating that they are identical to those tested in accordance with ASTM E84 for Class 1 characteristics listed below:
 - 1. Flame spread: 25 or less
 - 2. Smoke developed: 450 or less
- B. Impact Strength: Provide assembled wall protection units that have been tested in accordance with the applicable provisions of ASTM F476.
- C. Chemical and stain resistance: Provide wall protection system components with chemical and stain resistance in accordance with ASTM D543.
- D. Single source responsibility: Provide all components of the wall protection system manufactured by the same company to ensure compatibility of color, texture and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING:

- A. Deliver materials to the project site in unopened original factory packaging clearly labeled to show manufacturer.
- B. Store materials in original, undamaged packaging in a clean, dry place out of direct sunlight and exposure to the elements. A minimum room temperature of 40°F (4°C) and a maximum of 100°F (38°C) should be maintained.
- C. Materials must be stored flat.
- 1.5 PROJECT CONDITIONS

- A. Materials must be acclimated in an environment of 65-75°F (18-24°C) for at least 24 hours prior to beginning the installation.
- B. Installation areas must be enclosed and weatherproofed before installation commences.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Construction Specialties, Inc., (C/S Group) (Basis of Design).
- B. Inpro.
- C. Approved Equal.

2.2 MATERIAL:

- A. Extruded material should be textured, high impact rigid vinyl, "Acrovyn 4000" by C/S Group, integrally colored all exposed surfaces.
- B. Retainers: manufacturer's standard.
- C. Fasteners: All fasteners to be non-corrosive and compatible with aluminum retainers. All necessary fasteners to be supplied by the manufacturer.
- D. Color-matched sealant: Manufacturer's recommended sealant.
- E. Colors and textures as indicated on finish schedule.

2.3 CORNER GUARDS:

- A. Surface mounted with a continuous retainer with snap-on cover.
 - 1. Partial height, coordinate with wall protection covering.
 - 2. Provide color matched end caps.
 - 3. Attachment hardware shall be appropriate for wall construction.
 - 4. Model SM-20N 90° surface mounted corner guard with 3" legs, 1/4" radiused cover and retainer.
- B. Provide stainless steel corner guards where indicated on drawings.
 - 1. Stainless steel corner guard with 3-1/2 inch standard legs.
 - 2. Adhesive mounted.
 - 3. Partial height.
 - 4. Equal to C/S Group Model CO-8 Corner Guard.
 - 5. Provide C/S Group Model SCO-8 at end-of-wall conditions.

3.1 INSTALLATION:

- A. Coordinate installation of corner guards, crash rail and wall protection system with adjacent work.
- B. Do not install system items until after painting is complete.
- C. Temperature at the time of installation must be between 65-75°F (18-24°C) and be maintained for at least 48 hours after the installation to allow for proper adhesive set up.

WALL AND CORNER PROTECTION

- D. Relative humidity shall not exceed 80%.
- E. Do not expose wall covering to direct sunlight during or after installation. This will cause the surface temperature to rise, which in turn will cause bubbles and delamination.
- F. Install system items where indicated on drawings and schedules and in accordance with manufacturer's instructions.
- G. Install wall protection in strict accordance with the manufacturer's recommendations using approved adhesive.
- H. Provide corner guards 6 inches above finish floor and terminate 6 inches below finish ceiling.
- I. Secure retainer with fasteners as recommended by the manufacturer, appropriate for the substrate.
- J. Protect completed work from damage by other trades.

END OF SECTION

METAL LOCKERS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Three and two tiered locker units with hinged doors.
- B. Bottom, top, shelves and filler panels.
- C. Hooks, latches and hardware.

1.2 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data:
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.
- C. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Show locker trim and accessories.
 - 3. Include locker identification system and numbering sequence.
- D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.
- E. Qualification Data: For Installer.
- F. Sample Warranty: For special warranty.
- G. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.3 DELIVERY, STORAGE, AND HANDLING:

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.
- B. Deliver master and control keys to Owner by registered mail or overnight package service.

1.4 FIELD CONDITIONS:

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

1.5 COORDINATION:

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

METAL LOCKERS

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1.6 WARRANTY:

- A. Refer to Section 01770 Closeout Procedures for additional warranty requirements.
- B. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period
 - 1. Provide manufacturer's 10 year warranty for all defects in material and workmanship, from date of Substantial Completion.

PART 2 - PRODUCTS

- A. Basis of Design: Contract Documents are based on products specified below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and design concept expressed in Contract Documents is not changed, as determined by the Architect.
 - 1. Penco Products, Inc., which is located at: 2024 Cressman Rd. P. O. Box 158 ; Skippack, PA 19474-0158; Toll Free Tel: 800-562-1000; Tel: 610-666-0500; Fax: 610-666-7561; Email: General@PencoProducts.com; Web: www.pencoproducts.com
- B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers listed alphabetically below. If not listed. Submit as substitution according to Conditions of the Contract and Division 1 Sections.
 - 1. Art Metal Products: <u>www.artmetalproducts.com</u>.
 - 2. Republic Storage Systems Co: <u>www.republicstorage.com</u>.
 - 3. Salsbury Industries: www.lockers.com
- C. Substitutions: See Section 01630 Product Requirements.

2.2 PERFORMANCE REQUIREMENTS:

A. Accessibility Requirements: For lockers indicated to be accessible, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

2.3 METAL LOCKERS:

- A. Locker Units General:
 - 1. Width: 12 inches.
 - 2. Depth: 12 inches.
 - 3. Height: 72 inches.
 - 4. Configuration: 2 tier.
 - 5. Mounting: Surface mounted.
 - 6. Top: Sloped metal with closures.
 - 7. Locking: Equipped for padlock hasps.
 - 8. Ventilation Method: Door louvers.
 - 9. Class: Quiet.
 - 10. Form recess for operating handle and locking device.
 - 11. Finish edges smooth without burrs.
 - 12. Fabricate sloped metal tops, ends and closure pieces.
- B. ADA-Compliant Lockers (Recessed Handles with Multi-Point Latch):
 - 1. Double-tier lockers: Additional shelf at maximum 48 inches (1.219 m) above the floor for unobstructed forward and side reach.
 - 2. Locker Compartment Bottom: Minimum of 15 inches (230 mm) above the floor or an extra shelf placed 15 inches (381 mm) above the floor for unobstructed forward and

METAL LOCKERS

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side reach.

- 3. Handicapped symbol attached to door.
- 4. Hooks and rods as specified for other lockers.
- C. Lockers: Factory assembled, made of formed sheet steel, 16 gauge, stretcher leveled; metal edges finished smooth without burrs; durable powder coated finish inside and out.
 - 1. Where ends or sides are exposed, provide flush panel closures.
 - 2. Provide filler strips where indicated, securely attached to lockers.
 - 3. Color: To be selected by Architect.
 - 4. Includes a lift up handle and recessed hasp for added security.
- D. Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.
 - 1. Body and Shelves: 24 gage, 0.0239 inch.
 - 2. Base: 20 gage, 0.036 inch.
 - 3. Metal Base Height: 6" inch. Locker bases shall be fabricated from 0.0625 inch (1.59 mm) thick steel sheet. Same color as locker unit.
- E. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
 - 1. Door Frame: 16 gage, 0.0598 inch, minimum.
- F. Solid Doors:
 - 1. Outer door panel: 14 gauge formed sheet steel with double bends on both sides and single bends on top and bottom.
 - 2. Inner panel: 18 gauge formed sheet steel and securely welded to the outer door to form a reinforcing frame.
 - 3. Provide manufacturer's standard, multiple tiered louvers at all solid doors.
- G. Latching Mechanism: Single-point latching assembly with stainless steel recessed pan and padlock hasp.
- H. Hinges: 16 gauge continuous hinge piano hinge on right side.

2.4 ACCESSORIES:

- A. Hooks: Provide two (2) each single wall hooks and one (1) each double ceiling hook in each locker. Hooks shall be fabricated from forged steel with ball ends and zinc plated.
- B. Numbering
 - 1. Form numbers 1/2 inch high of block font style with ADA designation, in contrasting color.
 - 2. Furnish each locker with polished aluminum number plate with etched black numbers.
 - 3. Locate number plate near center of each door.
 - 4. Owner to furnish numbering sequence.

2.5 CONSTRUCTION:

- A. Locker shall be welded at seams and joints and all exposed welds sanded smooth.
- B. No bolts, screws, or rivets shall be used in assembly of main locker units.
- C. Ship lockers set-up, ready to be anchored in place in accordance with manufacturer's instructions.
- D. Sizes:
 - 1. 12 wide x 18 deep, 36 high (72 inch high two tier).

- E. Finish:
 - 1. Complete locker unit to be thoroughly cleaned, phosphatized and sealed.
 - 2. Finish to be baked pure TGIC polyester powder coat with a minimum 2-3 mil thickness.
 - 3. Color as shown on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lockers in accordance with manufacturer's instructions and accepted shop drawings.
- B. Install lockers secure, plumb, square, and in line.
- C. Bolt adjoining locker units together to provide rigid installation.
- D. Install end panels, sloped tops, filler panels and bases to completely close off openings.
- E. Adjust locker doors to open freely without binding.

END OF SECTION

METAL LOCKERS

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FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Fire extinguishers.
 - B. Cabinets.

1.2 RELATED SECTIONS:

- A. Section 09260 Gypsum Board Systems.
- B. Section 09900 Painting and Coatings.

1.3 REFERENCES:

- A. NFPA 10 Standard for Portable Fire Extinguishers; 2013.
- B. UL (FPED) Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.
- C. UL 299 Dry Chemical Fire Extinguishers.
- D. ASTM E814-13a Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.
- E. Comply with ANSI/UL92 and 711.
- F. Public Law 101-336 "2010 ADA Standards for Accessible Design (ADA) (Revised 15 September 2010).
- 1.4 1.4 SUBMITTALS:
 - A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
 - B. Shop Drawings: Indicate cabinet physical dimensions, rough-in measurements for recessed cabinets and accessories and floor plan showing location of each type of cabinet or mounting.
 - C. Product Data: Provide extinguisher operational features, color and finish, anchorage details and capacities.
 - D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- 1.5 1.5 OPERATION AND MAINTENANCE DATA:
 - A. Submit under provisions of Section 01700.
 - B. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.6 REGULATORY REQUIREMENTS:

A. Conform to ANSI/NFPA 10 for requirements for extinguishers.

1.7 ENVIRONMENTAL REQUIREMENTS:

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 - PRODU**CT**S

2.1 MANUFACTURERS:

- A. J.L. Industries.
- B. Larsen's Manufacturing Company.
- C. Potter-Roemer.
- D. Substitutions: See Section 01630 Product Substitutions.

2.2 EXTINGUISHERS

- A. Fire Extinguishers General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL for the purpose specified and indicated.
- B. Water type, UL 626, stainless steel tank, pressurized, Class 2A, 2.5 gallon capacity,
- C. Dry Chemical Type: UL 299, Steel tank, with pressure gage; with pressure gage, DOT approved, with epoxy finish.
 - 1. Stored Pressure Operated: Deep Drawn.
 - 2. Class: A: B: C.
 - 3. Capacity and UL Rating:
 - a. 10 pound, 4A-80B:C
 - b. 10 pound, 4A-80B:C
 - 4. Finish: Baked polyester powder coat, Red color.
 - 5. Temperature range: Minus 40 degrees F to 128 degrees F.
 - 6. Type Discharge: Hose
 - 7. Metal valves and siphon tube.
 - 8. Replaceable molded valve stem seal.

2.3 CABINETS:

- A. Metal: Steel with polyester coating, white with decals to match existing cabinets in adjacent locations.
- B. Cabinet: Standard roll-radius semi-recess with 2 inch projection. Similar to Potter-Roemer's "Alta" series.
- C. Configuration: Semi-recessed type with trim, sized to accommodate designated extinguishers. Provide rated cabinets for installation in rated wall assemblies. Cabinet shall be rated in accordance with ASTM E814. All cabinets shall include fire extinguisher brackets.
- D. Door: Full glass with handle and lock, match style of existing cabinets in adjacent locations. Provide piano hinge.

- E. Door Glazing: manufacturer's standard clear glass.
- F. Cabinet Mounting Hardware: Appropriate to cabinet.

2.4 ACCESSORIES:

- A. Extinguisher Brackets: Steel.
- B. Mounting hardware: As recommended by manufacturer for substrate.

PART 3 - EXECUTION

- 3.1 EXAMINATION:
 - A. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION:

- A. Install in accordance with manufacturer's instructions.
- B. Install at appropriate height so that extinguisher handle is a maximum of 54 inches above finished floor for compliance with ADA.
- C. Install cabinets plumb and level in wall openings.
- D. Secure rigidly in place.
- E. Place extinguishers in cabinets on wall brackets.

3.3 SERVICE:

A. Service, charge and tag each fire extinguisher within two weeks of substantial completion.

END OF SECTION

TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Toilet and washroom accessories.
 - B. Attachment hardware.

1.2 RELATED SECTIONS:

- A. Section 09260 Gypsum Board Systems.
- B. Section 09300 Ceramic Tile.
- C. Section 10175 Solid Surface Toilet Partitions.

1.3 REFERENCES:

- A. ANSI A117.1 Specifications for Making Buildings and Facilities Accessible To and Usable by Physically Handicapped People.
- B. ANSI/ASTM A366 Steel, Carbon, Cold-Rolled Sheet, Commercial Quality.
- C. ASTM A167 Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
- D. ASTM A269 Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- E. ADA Standards Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Shop Drawings: Indicate on elevations of individual room's location, mounting heights and required clearances. Provide mounting details including requirements for backing and special anchorage.
- C. Product Data: Provide manufacturer's data on accessories describing size, finish, details of function, attachment methods.

1.5 EXTRA MATERIAL:

- A. Submit in accordance with Section 01700 Spare Parts and Maintenance Materials.
- B. Provide two (2) keys for each accessory.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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- A. As noted on schedule.
- B. Other acceptable manufacturers are:
 - 1. Bradley Corp.
 - 2. Gamco Equipment
- C. Substitutions: Under provisions of Section 01630.

2.2 MATERIALS:

- A. Sheet Steel: ANSI/ASTM A366.
- B. Stainless Steel Sheet: ASTM A167, Type 304.
- C. Tubing: ASTM A269, stainless steel.
- D. Adhesive: Two component epoxy type, waterproof.
- E. Fasteners, Screws, and Bolts: Hot dip galvanized, tamperproof.
- F. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.
- G. Mounting Plates: As recommended by manufacturer.
- H. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.

2.3 FABRICATION:

- A. Weld and grind smooth joints of fabricated components.
- B. Form exposed surfaces from single sheet of stock, free of joints.
- C. Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- D. Back paint components where contact is made with building finishes to prevent electrolysis.
- E. Shop assemble components and package complete with anchors and fittings.
- F. Provide steel anchor plates, adapters, and anchor components for installation.
- G. Hot dip galvanize exposed and painted ferrous metal and fastening devices.
- 2.4 KEYING:
 - A. Provide 5 keys for each accessory to Owner; master key lockable accessories
- 2.5 FINISH:
 - A. Stainless Steel: No. 4 satin luster finish unless otherwise noted or scheduled.

PART 3 - EXECUTION

TOILET ROOM ACCESSORIES

3.1 EXAMINATION:

- A. Coordinate the work of this Section with the placement of internal wall reinforcement to receive anchor attachments where required by manufacturer.
- B. Verify that site conditions are ready to receive work, including mounting plates, and dimensions are as indicated on drawings.
- C. Beginning of installation means acceptance of existing substrate.

3.2 PREPARATION:

- A. Deliver inserts, rough-in frames and mounting plates to site at appropriate time for building-in. Provide templates and rough-in measurements as required.
- B. Verify exact location of accessories for installation.

3.3 INSTALLATION:

- A. Install fixtures, accessories and items in accordance with manufacturers' instructions.
- B. Mounting heights shall be as required to comply with ADA requirements and ANSI A117.1 unless noted otherwise on drawings and schedules.
- C. Install plumb and level, securely and rigidly anchored to substrate.
- D. Clean all surfaces.

END OF SECTION

SECURITY ACCESS SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Security access devices.
- B. Access control panel.

1.2 RELATED SECTIONS

- A. Section 08710 Door Hardware.
- B. Section 16100 Building Wire and Cable.

1.3 SYSTEM DESCRIPTION

- A. Security Access System: Control access to building and using encoded cards:
 - 1. All UNLV facility access control systems shall be equipped with the Ilco-Unican Marlok Millenium access control system components and hardware. The system shall be compatible with the campus Lockshop access control system. All system firmware and software must be of the most current version available at time of installation. All accessories and components related to building access control shall be evaluated for compatibility with the Ilco-Unican Marlok Millenium access control system. Systems not compatible with or adaptable for continuous operation and monitoring with the Ilco-Unican Marlok Millenium access control system of authorized for installation.
- B. Electric Strike Door Locking Systems.

1.4 SUBMITTALS

- A. Submit under provisions of General Conditions.
- B. Shop Drawings: Provide system wiring diagram showing each device and wiring connection required.
- C. Product Data: Provide electrical characteristics and connection requirements.
- D. Test Reports: Indicate satisfactory completion of required tests and inspections.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with NECA Standard of Installation.
- B. Maintain one copy of each reference document on site.
1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of General Conditions.
- B. Record actual locations of access authorization equipment.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of General Conditions.
- B. Operation Data: Operating instructions.
- C. Maintenance Data: Maintenance and repair procedures.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in installing the Products specified in this section with minimum three years documented experience.

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish Products listed and classified by UL as suitable for purpose specified and indicated.

1.10 MAINTENANCE SERVICE

A. Furnish service and maintenance of security access system for one year from Date of Substantial Completion. Provide a service agreement to owner for service after one year.

1.11 EXTRA MATERIALS

- A. Furnish under provisions of General Conditions.
- B. Provide 500 key cards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Marlock.
- C. Do not substitute manufacturers.

2.2 SECURITY ACCESS CONTROL EQUIPMENT

- A. Provide all components and materials required for a complete and operable system.
- B. Provide complete protection from weather in a factory approved manner for equipment located outdoors.

- C. Marlock Door Control Device.
- D. Marlock Battery Back Up Provide with batteries.
- E. Marlock Relay Control Device.
- F. Reader & Card Sensor Engineering Model #30387, Part # 3100300.
- G. Marlock Site Control.
- H. Marlock Modem Lease Line.
- I. Marlock RS232 Port Splitter.
- J. Panic Bar Securitron TSB-1.
- K. Time Delay Module Secruitron SN-TDMT-12.
- L. Power Supply Securitron BPS12-6.
- M. Battery Securitron 4A-NP712.
- N. Door Contacts Securitron 1048W.
- O. See drawings for location of equipment.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Install in accordance with manufacturer's instructions.
 - B. Use 16 AWG minimum size conductors for detection and signal circuit conductors. Install wiring in conduit.
 - C. Make conduit and wiring connections to door hardware devices furnished and installed under Section 08710.
- 3.2 FIELD QUALITY CONTROL
 - A. Field inspection and testing will be performed under provisions of General Conditions.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Provide manufacturer's field services under provisions of General Conditions.
- B. Include services of technician to supervise installation, adjustments, final connections, system testing, and training Owner's personnel.

3.4 DEMONSTRATION

- A. Provide systems demonstration under provisions of General Conditions.
- B. Demonstrate normal and abnormal modes of operation, and required response to each.

SECURITY ACCESS SYSTEMS

C. Training: Provide onsite training of security system. Coordinate with UNLV Security Department and UNLV lockshop.

END OF SECTION

SECURITY ACCESS SYSTEMS

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SECTION 13725

SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.
- B. Related Requirements:
 - 1. Section 07840 "Penetration Firestopping" for penetration firestopping installed in fireresistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
 - Material: Galvanized-steel sheet. 1.
 - 2. Minimum Metal Thickness:
 - For sleeve cross-section rectangle perimeter less than 50 inches and with no a. side larger than 16 inches, thickness shall be 0.052 inch.
 - For sleeve cross-section rectangle perimeter 50 inches or more and one or b. more sides larger than 16 inches, thickness shall be 0.138 inch).

2.2 SLEEVE-SEAL SYSTEMS

- Α. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - Advance Products & Systems, Inc. a.
 - CALPICO, Inc. b.
 - Metraflex Company (The). C.
 - Pipeline Seal and Insulator, Inc. d.
 - Proco Products, Inc. e.
 - Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include 3. type and number required for pipe material and size of pipe.
 - Pressure Plates: Carbon steel. 4.
 - 5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating.

SLEEVE-SEAL FITTINGS 2.3

- Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in Α. concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - Manufacturers: Subject to compliance with requirements, available manufacturers 1. offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following: Presealed Systems.
 - a.

2.4 GROUT

- Α. Description: Nonshrink; recommended for interior and exterior sealing openings in non-firerated walls or floors.
- Β. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

- 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS
 - A. Comply with NECA 1.
 - B. Comply with NEMA VE 2 for cable tray and cable penetrations.
 - C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07900 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
 - D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
 - E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
 - F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [steel] [cast-iron] pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION

SECTION 13726

CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Ladder cable trays.
 - 2. Wire-basket cable trays.
 - 3. Single-rail cable trays.
 - 4. Trough cable trays.
 - 5. Fiberglass cable trays.
- B. Related Requirements:
 - Section 16133 "Cable Trays for Electrical Systems" for cable trays and accessories serving electrical systems.

1.3 ACTION SUBMITTALS

1

- A. Product Data: For each type of cable tray.
 - 1. Include data indicating dimensions and finishes for each type of cable tray indicated.
- B. Shop Drawings: For each type of cable tray.
 - 1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
- C. Delegated-Design Submittal: For seismic restraints.
 - 1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
 - 2. Design Calculations: Calculate requirements for selecting seismic restraints.
 - 3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
 - 2. Vertical and horizontal offsets and transitions.
 - 3. Clearances for access above and to side of cable trays.
 - 4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.
- B. Seismic Qualification Certificates: For cable trays, accessories, and components, from manufacturer.

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- 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
- 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01400 "Quality Requirements," to design cable tray supports and seismic bracing.
- B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. Component Importance Factor: 1.5.
 - 3. See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table for requirements to be inserted in subparagraph below.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
 - 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
- C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:
 - 1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
 - 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
 - 3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.3 LADDER CABLE TRAYS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 2. Chalfant Manufacturing Company.

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- 3. Cooper B-Line, Inc.
- 4. Mono-Systems, Inc.
- 5. MP Husky.
- 6. Niedax-Kleinhuis USA, Inc.
- C. Description:
 - 1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
 - 2. Rung Spacing 9 inches o.c.
 - 3. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
 - 4. Minimum Cable-Bearing Surface for Rungs: 7/8-inch width with radius edges.
 - 5. No portion of the rungs shall protrude below the bottom plane of side rails.
 - 6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb concentrated load, when tested according to NEMA VE 1.
 - 7. Minimum Usable Load Depth: 4 inches.
 - 8. Straight Section Lengths: 10 feet (3 m) except where shorter lengths are required to facilitate tray assembly.
 - 9. Width: 12 inches unless otherwise indicated on Drawings.
 - 10. Fitting Minimum Radius: 12 inches.
 - 11. Class Designation: Comply with NEMA VE 1, Class 12B.
 - 12. Splicing Assemblies: Bolted type using serrated flange locknuts.
 - 13. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316
 - 14. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.4 WIRE-BASKET CABLE TRAYS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 2. Cablofil/Legrande.
 - 3. Chalfant Manufacturing Company.
 - 4. Cooper B-Line, Inc.
 - 5. Enduro Systems, Inc.
 - 6. Mono-Systems, Inc.
 - 7. MP Husky.
 - 8. Niedax-Kleinhuis USA, Inc.
 - 9. Snaketray.
 - 10. Wiremaid Products Division; Vutec Corporation.
- C. Description:
 - 1. Configuration: Wires are formed into a standard 2-by-4-inch wire mesh pattern with intersecting wires welded together. Mesh sections must have at least one bottom longitudinal wire along entire length of section.
 - 2. Materials: High-strength-steel longitudinal wires with no bends.
 - 3. Safety Provisions: Wire ends along wire-basket sides (flanges) rounded during manufacturing to maintain integrity of cables and installer safety.
 - 4. Sizes:
 - a. Straight sections shall be furnished in standard 118-inch lengths.
 - b. Wire-Basket Depth: 1-inch usable loading depth by 12 inches wide.
 - c. Wire-Basket Depth: 2-inch usable loading depth by 8 inches wide.
 - d. Wire-Basket Depth: 4-inch usable loading depth by 24 inches wide.
 - e. Wire-Basket Depth: 6-inch usable loading depth by 24 inches wide.

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- 5. Connector Assemblies: Bolt welded to plate shaped to fit around adjoining tray wires and mating plate. Mechanically joins adjacent tray wires to splice sections together or to create horizontal fittings.
- 6. Connector Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
- 7. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316

2.5 SINGLE-RAIL CABLE TRAYS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 2. Cooper B-Line, Inc.
 - 3. Mono-Systems, Inc.
 - 4. MP Husky.
- C. Description:
 - 1. Configuration: Center rail with extruded-aluminum rungs arranged symmetrically about the center rail.
 - 2. Construction: Aluminum rungs mechanically connected to aluminum center rail in at least two places, with ends finished to protect installers and cables.
 - 3. Rung Spacing 9 inches o.c.
 - 4. Radius-Fitting Rung Spacing: 9 inches at center of tray's width.
 - 5. Straight Section Lengths: 10 feet except where shorter lengths are required to facilitate tray assembly.
 - 6. Width: 12 inches unless otherwise indicated on Drawings.
 - 7. Support Point: Splice fittings shall be hanger support point.
 - 8. Support Spacing: Support each section at midpoint. Support wall-mounted sections a maximum of one-sixth of the section length from each end.
 - 9. Loading Depth: 4 inches.
 - 10. Maximum Loads: 25 lb/ft.
 - 11. Splicing Assemblies: Bolted type using serrated flange locknuts.
 - 12. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.
 - 13. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316.
 - 14. Splices and Connectors: Protect cables from edges of center rail and do not intrude into cable fill area.

2.6 MATERIALS AND FINISHES

- A. Steel:
 - 1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1011/A 1011M, SS, Grade 33.
 - 2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
 - 3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
 - 4. Finish: Mill galvanized before fabrication.
 - a. Standard: Comply with ASTM A 653/A 653M, G90 (Z275).
 - b. Hardware: Chromium-zinc plated, ASTM F 1136.
 - 5. Finish: Electrogalvanized before fabrication.
 - a. Standard: Comply with ASTM B 633.
 - b. Hardware: Galvanized, ASTM B 633.
 - Finish: Hot-dip galvanized after fabrication.
 - a. Standard: Comply with ASTM A 123/A 123M, Class B2.

6.

- b. Hardware: Chromium-zinc plated, ASTM F 1136].
- 7. Finish: [Epoxy-resin] [Powder-coat enamel] paint.
 - a. Powder-Coat Enamel: Cable tray manufacturer's recommended primer and corrosion-inhibiting treatment, with factory-applied powder-coat paint.
 - b. Epoxy-Resin Prime Coat: Cold-curing epoxy primer, MPI# 101.
 - c. Epoxy-Resin Topcoat: Epoxy, cold-cured, gloss, MPI# 77.
 - d. Hardware: Chromium-zinc plated, ASTM F 1136.
- 8. Finish: Factory-standard primer, ready for field painting, with chromium-zinc-plated hardware according to ASTM F 1136.
- 9. Finish: Black oxide finish for support accessories and miscellaneous hardware according to ASTM D 769.
- B. Aluminum:
 - 1. Materials: Alloy 6063-T6 according to ANSI H 35.1/H 35.1M for extruded components and Alloy 5052-H32 or Alloy 6061-T6 according to ANSI H 35.1/H 35.1M for fabricated parts.
 - 2. Hardware: Chromium-zinc-plated steel, ASTM F 1136.
 - 3. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.
- C. Stainless Steel:
 - 1. Materials: Low-carbon, passivated, stainless steel, Type 304L or Type 316L, ASTM F 593 and ASTM F 594.
 - 2. Hardware for Stainless-Steel Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.
- 2.7 CABLE TRAY ACCESSORIES
 - A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
 - B. Covers: Solid type made of same materials and with same finishes as cable tray.
 - C. Barrier Strips: Same materials and finishes as for cable tray.
 - D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.
- 2.8 WARNING SIGNS
 - A. Lettering: 1-1/2-inch high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."
 - B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical Systems."
- 2.9 SOURCE QUALITY CONTROL
 - A. Testing: Test and inspect cable trays according to NEMA FG 1.

PART 3 - EXECUTION

- 3.1 CABLE TRAY INSTALLATION
 - A. Install cable trays according to NEMA FG 1.

- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure and install seismic restraints.
- G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb. Comply with requirements in Section 16070 "Hangers and Supports for Electrical Systems." Comply with seismic-restraint details according to Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- J. Support bus assembly to prevent twisting from eccentric loading.
- K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
- L. Locate and install supports according to NEMA FG 1. Do not install more than one cable tray splice between supports.
- M. Support wire-basket cable trays with center support hangers.
- N. Support center support hangers for wire-basket trays with 1/4-inch diameter rods.
- O. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- P. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA FG 1. Space connectors and set gaps according to applicable standard.
- Q. Make changes in direction and elevation using manufacturer's recommended fittings.
- R. Make cable tray connections using manufacturer's recommended fittings.
- S. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 07840 "Penetration Firestopping."
- T. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

- U. Install cable trays with enough workspace to permit access for installing cables.
- V. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.
- W. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.
- X. Clamp covers on cable trays installed outdoors with heavy-duty clamps.
- Y. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 16060 "Grounding and Bonding for Electrical Systems."
- B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Cable trays with control conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
- E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.3 CABLE INSTALLATION

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 18 inches.
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches.
- E. Tie MI cables down every 36 inches where required to provide a 2-hour fire rating and every 72 inches elsewhere.
- F. In existing construction, remove inactive or dead cables from cable trays.

3.4 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
 - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
 - 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
 - 4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
 - 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
 - 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
 - 7. Check for improperly sized or installed bonding jumpers.
 - 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
 - 9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.
- B. Prepare test and inspection reports.

3.6 PROTECTION

- A. Protect installed cable trays and cables.
 - 1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
 - 2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
 - 3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION

SECTION 13728

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Optical-fiber-cable pathways and fittings.
 - 4. Metal wireways and auxiliary gutters.
 - 5. Nonmetallic wireways and auxiliary gutters.
 - 6. Surface pathways.
 - 7. Boxes, enclosures, and cabinets.
 - 8. Handholes and boxes for exterior underground cabling.
- B. Related Requirements:
 - 1. Section 16136 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
 - 2. Section 16128 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.
 - 3. Section 16135 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

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C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of pathway groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, equipment racks and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.
- D. Source quality-control reports.

PART 2 - PRODUCTS

- 2.1 METAL CONDUITS AND FITTINGS
 - A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 3. Alpha Wire Company.
 - 4. Anamet Electrical, Inc.
 - 5. Electri-Flex Company.
 - 6. O-Z/Gedney; a brand of EGS Electrical Group.
 - 7. Picoma Industries; Subsidiary of Mueller Water Products, Inc.
 - 8. Republic Conduit.
 - 9. Robroy Industries.
 - 10. Southwire Company.
 - 11. Thomas & Betts Corporation.
 - 12. Western Tube and Conduit Corporation.
 - 13. Wheatland Tube Company; a division of John Maneely Company.
 - B. General Requirements for Metal Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.
 - C. GRC: Comply with ANSI C80.1 and UL 6.
 - D. ARC: Comply with ANSI C80.5 and UL 6A.

- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch, minimum.
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Setscrew or compression.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 3. Anamet Electrical, Inc.
 - 4. Arnco Corporation.
 - 5. CANTEX Inc.
 - 6. CertainTeed Corp.
 - 7. Condux International, Inc.
 - 8. Electri-Flex Company.
 - 9. Kraloy.
 - 10. Lamson & Sessions; Carlon Electrical Products.
 - 11. Niedax-Kleinhuis USA, Inc.
 - 12. RACO; a Hubbell company.
 - 13. Thomas & Betts Corporation.
- B. General Requirements for Nonmetallic Conduits and Fittings:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Rigid HDPE: Comply with UL 651A.
- E. Continuous HDPE: Comply with UL 651B.
- F. RTRC: Comply with UL 1684A and NEMA TC 14.
- G. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

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- H. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- I. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Alpha Wire Company.
 - 2. Arnco Corporation.
 - 3. Endot Industries Inc.
 - 4. IPEX.
 - 5. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Comply with UL 2024; flexible-type pathway, approved for plenum or general-use installation unless otherwise indicated.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.

2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman; a Pentair company.
 - 3. Mono-Systems, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, vailable manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Allied Moulded Products, Inc.
 - 2. Hoffman; a Pentair company.
 - 3. Lamson & Sessions; Carlon Electrical Products.
 - 4. Niedax-Kleinhuis USA, Inc.
- B. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:

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- 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 2. Comply with TIA-569-B.
- C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 SURFACE PATHWAYS

- A. General Requirements for Surface Pathways:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.
- B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Mono-Systems, Inc.
 - b. Niedax-Kleinhuis USA, Inc.
 - c. Panduit Corp.
 - d. Wiremold / Legrand.
- C. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL-94 V-0 requirements for self-extinguishing characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems Division.
 - b. Lamson & Sessions; Carlon Electrical Products.
 - c. Mono-Systems, Inc.
 - d. Panduit Corp.
 - e. Wiremold / Legrand.
- D. Tele-Power Poles:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Mono-Systems, Inc.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.
- 2. Material: Galvanized steel with ivory baked-enamel finish.
- 3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.7 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Adalet.
 - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
 - 3. EGS/Appleton Electric.
 - 4. Erickson Electrical Equipment Company.
 - 5. Hoffman; a Pentair company.
 - 6. Hubbell Incorporated; Killark Division.
 - 7. Lamson & Sessions; Carlon Electrical Products.
 - 8. Milbank Manufacturing Co.
 - 9. Molex; Woodhead Brand.
 - 10. Mono-Systems, Inc.
 - 11. O-Z/Gedney; a brand of EGS Electrical Group.
 - 12. RACO; a Hubbell company.
 - 13. Robroy Industries.
 - 14. Spring City Electrical Manufacturing Company.
 - 15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
 - 16. Thomas & Betts Corporation.
 - 17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets:
 - 1. Comply with TIA-569-B.
 - 2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- F. Metal Floor Boxes:
 - 1. Material: Cast metal or sheet metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- G. Nonmetallic Floor Boxes: Nonadjustable, round.
 - 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- J. Device Box Dimensions: 4 inches square by 2-1/8 inches.
- K. Gangable boxes are allowed.
- L. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250 Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures:
 - a. Material: Fiberglass.
 - b. Finished inside with radio-frequency-resistant paint.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- N. Cabinets:
 - 1. NEMA 250, Type 3R, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.8 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND CABLING

- A. General Requirements for Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. Comply with TIA-569-B.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation; Hubbell Power Systems.
 - d. NewBasis.
 - e. Oldcastle Precast, Inc.; Christy Concrete Products.

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- f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
- 3. Standard: Comply with SCTE 77.
- 4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
- 5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
- 6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- 7. Cover Legend: Molded lettering, "COMMUNICATIONS.".
- 8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- 9. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.
- C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawingsor comparable product by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation; Hubbell Power Systems.
 - d. NewBasis.
 - e. Nordic Fiberglass, Inc.
 - f. Oldcastle Precast, Inc.; Christy Concrete Products.
 - g. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
 - 3. Standard: Comply with SCTE 77.
 - 4. Color of Frame and Cover: Gray.
 - 5. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 - 6. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 - 7. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 8. Cover Legend: Molded lettering, "COMMUNICATIONS.".
 - 9. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 10. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.9 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by an independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed Conduit: RNC, Type EPC-40-PVC.

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- 2. Concealed Conduit, Aboveground: EMT.
- 3. Underground Conduit: RNC, Type EPC-40-PVC.
- 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT or RNC.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Exposed and Subject to Severe Physical Damage: IMC. Pathway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums
 - Concealed in Ceilings and Interior Walls and Partitions: EMT or innerduct.
 - 5. Damp or Wet Locations: IMC.

4.

- 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, communications-cable pathway.
- 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Risertype, communications-cable pathway.
- 8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: Plenum-type, optical-fiber-cable pathway, [Plenum-type, communications-cable pathway.
- 9. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 nonmetallic in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Pathway Size: 3/4-inch trade size. Minimum size for optical-fiber cables is 1 inch.
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.

- D. Comply with requirements in Section 16070 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Pathways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from ENT to RNC, Type EPC-40-PVC, or IMC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- P. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- R. Surface Pathways:
 - 1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 - 2. Install surface pathway with a minimum 2-inch radius control at bend points.

PATHWAYS FOR COMMUNICATIONS SYSTEMS

- 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
 - 1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
 - 2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- T. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.
- U. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service pathway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- W. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F) and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

- X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.
- Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- CC. Set metal floor boxes level and flush with finished floor surface.
- DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31200 "Earth Moving" for pipe less than 6 inches in nominal diameter.
 - 2. Install backfill as specified in Section 31200 "Earth Moving."
 - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31200 "Earth Moving."
 - 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
 - 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
 - 6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, but a minimum of 6 inches below grade. Align planks along centerline of conduit.
 - 7. Underground Warning Tape: Comply with requirements in Section 16075 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- F. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 13725 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07840 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 13851

FIRE ALARM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fire alarm control panels, manual fire alarm stations, automatic smoke and heat detectors, fire alarm signaling appliances, and auxiliary fire alarm equipment and power and signal wire and cable.
- B. Related Sections:
 - 1. Section 08710 Door Hardware: Door closers, electric locks, electric releases.
 - 2. Section 13930 Wet-Pipe Sprinkler Systems: Flow detection and alarm devices.
 - 3. Section 13935 Dry-Pipe Sprinkler Systems: Flow detection and alarm devices.
 - 4. Section 13975 Fire-Suppression Standpipes: Flow detection and alarm devices.
 - 5. Division 25 Duct Accessories: Smoke dampers.
 - 6. Section 16100 Building Wire and Cables.

1.2 REFERENCES

- A. NFPA 72 (National Fire Protection Association) Installation, Maintenance, and Use of Protective Signaling Systems.
- B. NFPA 72E (National Fire Protection Association) Automatic Fire Detectors.
- C. NFPA 72G (National Fire Protection Association) Notification Appliances for Protective Signaling Systems.
- D. NFPA 72H (National Fire Protection Association) Guide for Test Procedures for Protective Signaling Systems.

1.3 SYSTEM DESCRIPTION

- A. Fire Alarm System: NFPA 72, addressable, manual and automatic local fire alarm system with connections to central station.
- B. Alarm Sequence of Operation: Actuation of initiating device causes the following system operations:
 - 1. Local fire alarm signaling devices sound and display with signal.
 - 2. Zone-coded signal transmits to central station.
 - 3. Location of alarm zone indicates on fire alarm control panel and on remote annunciator panel.
 - 4. Signal transmits to building elevator control panel, initiating return to main floor or alternate floor and lockout for fire service.
 - 5. Signal transmits to building mechanical controls, shutting down fans and operating dampers.
 - 6. Signal transmits to release door hold-open devices.
 - 7. Signal releases magnetic door hold opens.
 - 8. Signal releases electric door locks.
- C. Drill Sequence of Operation: Manual drill function causes alarm mode sequence of operation.

- D. Trouble Sequence of Operation: System or circuit trouble causes the following system operations:
 - 1. Visual and audible trouble alarm indicates at fire alarm control panel.
 - 2. Visual and audible trouble alarm indicates at remote annunciator panel.
 - 3. Trouble signal transmits to central station.
- E. Zoning: As indicated on Drawings.

1.4 SUBMITTALS

- A. Submit under provisions of General Conditions.
- B. Shop Drawings: Indicate system wiring diagram showing each device and wiring connection; indicate annunciator layout, and design calculations. Include in drawings any additional devices not shown on drawings but required to make system operational and to obtain approval by Fire Marshall. Additional devices shall be included at no additional cost to the owner.
- C. Product Data: Submit catalog data showing electrical characteristics and connection requirements.
- D. Test Reports: Indicate procedures and results for specified field testing and inspection.
- E. Manufacturer's Field Reports: Indicate activities on site, adverse findings, and recommendations.

1.5 CLOSEOUT SUBMITTALS

- A. Submit under provisions of General Conditions.
- B. Project Record Documents: Record actual locations of fire alarm equipment.
- C. Operation and Maintenance Data: Submit manufacturer's standard operating and maintenance instructions.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 50 miles of project.
- B. Installer: Company specializing in installing the products specified in this section with a minimum of 3 years documented experience, and certified in the State of Nevada as a fire alarm installer.

1.7 MAINTENANCE SERVICE

A. Furnish service and maintenance of fire alarm equipment for one year from Date of Substantial Completion. Include in service-programming changes to system to meet owner's requirements.

1.8 MAINTENANCE MATERIALS

A. Provide under provisions of General Conditions.

B. Furnish six keys of each type.

1.9 EXTRA MATERIALS

- A. Provide under provisions of General Conditions.
- B. Furnish 12 of each type of automatic smoke detector.

PART 2 - PRODUCTS

2.1 CONTROL PANEL

- A. Manufacturers:
 - 1. Existing Honeywell system.
- B. Product Description: Existing modular fire alarm control panel with surface wall-mounted enclosure. Add to the existing fire alarm panel any of the following equipment as required to tie in the new devices on the first and second floors.
- C. Power supply: Adequate to serve control panel modules, remote detectors, remote annunciators, smoke dampers, relays, and alarm signaling devices. Include battery-operated emergency power supply with capacity for operating system in standby mode for 24 hours followed by alarm mode for 5 minutes.
- D. System Supervision: Component or power supply failure places system in trouble mode.
- E. Initiating Device Circuits: Addressable supervised zone module with alarm and trouble indication; occurrence of single ground or open condition places circuit in trouble mode but does not disable circuit from initiating alarm.
- F. Indicating Appliance Circuits: Supervised signal module, sufficient for signal devices connected to system; occurrence of single ground or open condition places circuit in trouble mode but does not disable circuit from signaling alarm.
- G. Remote Station Signal Transmitter: Electrically supervised digital alarm communicator transmitter, capable of transmitting alarm and trouble signals over telephone lines to central station receiver.
- H. Auxiliary Relays: Sufficient SPDT auxiliary relay contacts for each detection zone to provide accessory functions specified.

2.2 MANUAL FIRE ALARM STATIONS

- A. Product Description: Addressable, double action manual station.
- B. Mounting: Semi-Flush.
- C. Backbox: Manufacturer's standard.

2.3 SPOT HEAT DETECTOR

- A. Product Description: Addressable, Combination rate-of-rise and fixed temperature, spot heat detector.
- B. Temperature Rating: 135 degrees F (57 degrees C).

C. Rate-of-Rise: 15 degrees F (8.3 degrees C).

2.4 CEILING SMOKE DETECTOR

- A. Product Description: Addressable, NFPA 72E, photoelectric type ceiling smoke detector with the following features:
 - 1. Adjustable sensitivity.
 - 2. Plug-in base.
 - 3. Visual indication of detector actuation.
- B. Mounting: 4 inch (102 mm) outlet box.
- C. Furnish two-wire detector with common power supply and signal circuits.

2.5 DUCT-MOUNTED SMOKE DETECTOR

- A. Product Description: Addressable, NFPA 72E, photoelectric type with the following features:
 - 1. Auxiliary SPDT relay contact.
 - 2. Key-operated normal-reset-test switch.
 - 3. Duct sampling tubes extending width of duct.
 - 4. Visual indication of detector actuation.
 - 5. Duct-mounted housing.
- B. Furnish two-wire detector with common power supply and signal circuits.

2.6 ALARM BELLS

- A. Product Description: NFPA 72G, single-stroke, electric bell with the following features:
 - 1. Operating mechanism behind dome.
 - 2. Integral strobe lamp and flasher with red lettered "FIRE" on white lens.
 - 3. Size: 8 inch.
 - 4. Sound Rating: 81 dB at 10 feet.

2.7 ALARM LIGHTS

A. Product Description: NFPA 72G, strobe lamp and flasher with red lettered "FIRE" on white lens.

2.8 ALARM HORN

- A. Product Description: NFPA 72G, flush type fire alarm horn with the following features:
 - 1. Sound Rating: 87 dB 10 feet (3 M).
 - 2. Integral strobe lamp and flasher with red lettered "FIRE" on white lens.
- B. Product Description: Exterior mounted horn with the following features:
 - 1. Sound Rating: 87 dB at 10 feet.
 - 2. Integral strobe lamp and flasher with red lettered "FIRE" on white lens.

2.9 REMOTE ANNUNCIATOR

- A. Product Description: Supervised remote annunciator including audible and visual indication of fire alarm by zone, and audible and visual indication of system trouble.
- B. Mounting: Factory mounted in flush wall-mounted enclosure.

2.10 DOOR RELEASE

- A. Product Description: Magnetic door holder with integral diodes to reduce buzzing.
- B. Coil voltage: 24 VDC.

2.11 WIRE AND CABLE

- A. Product Description: Power limited fire-protective signaling cable, copper conductor, 300 volts insulation rated 105 degrees C.
- B. Fire alarm circuit conductors have insulation color or code as follows:
 - 1. Power Branch Circuit Conductors: Black, red, white.
 - 2. Initiating Device Circuit: Black, red.
 - 3. Detector Power Supply: Violet, brown.
 - 4. Signal Device Circuit: Blue (positive), white (negative).
 - 5. Door Release: Gray, gray.
 - 6. Municipal Trip Circuit: Orange, orange.
 - 7. Municipal Fire Alarm Loop: Black, white.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01300 Administrative Requirements: Coordination and project conditions.
- B. Verify products and systems receiving devices are ready for installation.

3.2 EXISTING WORK

- A. Remove exposed abandoned fire alarm wiring, including abandoned wiring above accessible ceiling finishes. Cut cable flush with walls and floors, and patch surfaces.
- B. Disconnect and remove abandoned fire alarm equipment.
- C. Maintain access to existing fire alarm equipment and other installations remaining active and requiring access. Modify installation or provide access panel.

3.3 INSTALLATION

- A. Install manual station with operating handle 4 feet 6 inches above floor.
- B. Install audible and visual signal devices 7 feet 6 inches above floor.
- C. Install 16 AWG minimum size conductors for fire alarm detection and signal circuit conductors in conduit.
- D. Mount end-of-line device in box with last device or separate box adjacent to last device in circuit.
- E. Mount outlet box for electric door holder to withstand 80 pounds pulling force.
- F. Connect conduit and wire to door release devices, sprinkler flow switches, sprinkler valve tamper switches, fire suppression system control panels, duct smoke detectors and fire/smoke dampers.

- G. Automatic Detector Installation: Conform to NFPA 72E.
- H. Install engraved plastic nameplates in accordance with Section 16075.
- I. Ground and bond fire alarm equipment and circuits in accordance with Section 16075.

3.4 FIELD QUALITY CONTROL

- A. Section 01400- Quality Requirements: Testing and inspection services.
- B. Test in accordance with NFPA 72H and local fire department requirements.
- 3.5 MANUFACTURER'S FIELD SERVICES
 - A. Section 01400 Quality Requirements: Manufacturer's field services.
 - B. Include services of certified technician to supervise installation, adjustments, final connections, and system testing.
- 3.6 DEMONSTRATION AND TRAINING
 - A. Furnish 2 hours of instruction each for two persons, to be conducted at project site with manufacturer's representative.

END OF SECTION

SECTION 13910

BASIC FIRE SUPPRESSION MATERIALS AND METHODS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS AND SPECIAL CONDITIONS

- A. Division 1 General Requirements of these specifications shall apply to the work in this section.
- B. The Contractor shall furnish all equipment, materials, tools, labor, engineering, drawings, etc. necessary for a complete fire protection system, with said systems being made ready for operation in accordance with the requirements of NFPA, NFC, and the authorities having jurisdiction. The purpose of the Engineer specifications and drawings is to convey to the Contractor the scope of work required, all of which the Contractor is responsible to furnish, install, adjust, and make operable. The omission by Engineer of any necessary system component as required by the authorities having jurisdiction, in the specifications and drawings shall not relieve the Contractor of the responsibility for providing such necessity, without additional cost to the Owner. The Contractor shall visit the site before submitting his bid and shall examine all existing physical conditions which may be material to the performance of his work. No extra payments will be allowed to the Contractor as a result of extra work made necessary by his failure to do so. Any case of error, omission, discrepancy or lack of clarity shall be promptly identified to the Designer/Builder and Engineer for clarification prior to the bid due date.
- C. The Contractor shall provide all devices and equipment required by these specifications and drawings. Under no circumstances will the Contractor delete any equipment or devices without the written directive of the Owner.

1.2 PERFORMANCE GUIDELINES

- A. Work provided under this section
 - 1. Site visit to determine existing conditions and extent of work.
 - 2. Review of project drawings to determine extent of work.
 - 3. Complete fire protection systems as outlined in these specifications, including all labor, materials and shop drawings needed to furnish and install a complete automatic sprinkler system, and all of the following:
 - a. Siamese-type fire department connection with check valve and ball drip on the outside wall of the riser room or location approved by AHJ.
 - b. Core drilling of floors and walls, and required firestopping. Patch as required.
 - c. Wet pipe fire sprinkler systems, complete with supervised control valves, flow switch, drain piping and inspector's test valve.
 - d. Coordination of work with all other trades including coordination of sleeved holes in the main precast concrete floor beams.
 - e. Shop drawings.
 - f. Operating instructions and valve diagrams.
 - g. As-built drawings.
 - h. Waterflow and valve supervisory switches.
 - i. Sleeves.
 - j. Inserts.
 - k. Cutting and patching.
 - I. Cutting and patching required for new concealed piping installations in existing dropped ceiling areas. After completion of the work, ceilings shall match the existing ceilings in every respect. Only qualified workmen familiar with this type of work shall be employed.

BASIC FIRE SUPPRESSION MATERIALS AND METHODS

1.3 SYSTEM ABBREVIATIONS AND DEFINITIONS

- A. Approved: Unless otherwise stated, materials, equipment or submittals approved by the Engineer.
- B. ANSI: American National Standards Institute.
- C. Architect: Tate Snyder Kimsey.
- D. ASTM: American Society for Testing and Materials.
- E. AWS: American Welding Society.
- F. AWWA: American Water Works Association.
- G. Concealed: Where used in connection with installation of piping or conduit and accessories, shall mean "hidden from sight" as in shafts, furred spaces, in soffits or above suspended ceilings.
- H. Contractor: The Company awarded the prime contract for this work and any of its subcontractors, vendors, suppliers or fabricators.
- I. CLVFR: City of Las Vegas Fire & Rescue.
- J. DP: Dry pendent sprinkler.
- K. EC: Extended coverage sprinkler.
- L. ELO: Extra-large orifice sprinkler.
- M. Engineer: Schirmer Engineering Corporation (SEC).
- N. Exposed: Where used in connection with installation of piping or conduit and accessories, shall mean "visible" or "not concealed".
- O. FDC: Fire department connection.
- P. FM: Factory Mutual.
- Q. FM Approved: Materials or equipment approved by Factory Mutual and included in the most recent edition of the FM Approval Guide.
- R. Furnish: Supply materials.
- S. Gpm: Gallons per minute.
- T. Install: Install materials, mount and connect equipment or assemblies.
- U. NFPA: National Fire Protection Association.

1.4 RELATED WORK

- A. Materials and methods specified in other sections:
 - 1. Underground piping terminating in the fire riser room.

BASIC FIRE SUPPRESSION MATERIALS AND METHODS

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- 2. Painting of sprinkler piping, hangers, and valves, including placing and removal of bags or other protection devices on sprinklers to prevent paint from touching any portion of a sprinkler.
- 3. Painting of finished surfaces at pipe penetrations.
- 4. Construction of new 1-hour rated riser room as indicated on the design drawings.
- 5. Adequate heat for valve and riser rooms.
- B. Materials furnished and installed in this section but wired by Others:
 - 1. Valve supervisory devices shall be furnished and installed by the sprinkler contractor but wired by the alarm contractor.
 - 2. Waterflow switches shall be furnished and installed by the sprinkler contractor but wired by the alarm contractor.

1.5 DESIGN CRITERIA

- A. Sprinkler Systems:
 - 1. Provide a wet pipe sprinkler system with quick response, upright, pendent, and extended coverage sprinklers as indicated on the fire sprinkler contractor plans for complete protection of all areas with pipe sized per hydraulic calculations.
 - 2. All areas excluding outdoor covered walkways to be protected with wet pipe system. These are to be considered in the hydraulic calculations.
 - a. Light Hazard density 0.10 gpm per 1,500 ft² for class rooms, offices and assembly spaces.
 - b. Ordinary Hazard, Group 1 density 0.15 gpm per 1,500 ft² for kitchen and services area, mechanical room.
 - c. Ordinary Hazard, Group 2 0.20 gpm per 1,500 ft² for storage areas, auto shop and wood shop.
 - 3. Any changes in design area, number of sprinklers operating, pipe schedule, pipe sizes, number of branch lines, number of mains or deviation from water supply as stated on the drawings shall necessitate complete hydraulic calculations by the Contractor and approval of changes by SEC prior to fabrication of pipe.
 - 4. Location of sprinkler head spacing shall be approved by the Architect before the start of construction.
 - 5. Contractor shall submit calculations along with the shop drawings.
- B. Area Hydraulics
 - 1. System designed per a waterflow tested conducted within 12 months of the submitted calculations. A flow test conducted by SEC is acceptable.

1.6 APPLICABLE STANDARDS

- A. Reference Standards: The following standards are included as part of this specification:
 - 1. National Fire Protection Association (NFPA):
 - a. NFPA 13 Standard for the Installation of Sprinkler Systems.
 - b. NFPA 14 Standard for the Installation of Standpipe and Hose Systems.
 - c. NFPA 25 Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.
 - 2. American National Standards Institute, Inc. (ANSI) Standards, current editions:
 - a. A21.4 Cement-Mortar Lining for Cast-Iron and Ductile-Iron Pipe and Fittings for Water.
 - b. A21.6 Cast-Iron Pipe Centrifugally Cast in Metal Molds, for Water or Other Liquids.
 - c. A21.8 Cast-Iron Pipe Centrifugally Cast in Sand-Lined Molds, for Water or Other Liquids.
 - d. A21.10 A21.10 a Gray-Iron and Ductile-Iron Fittings, 2 inch through 48 inch for Water and Other Liquids.

- e. A21.11 Rubber-Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings.
- f. A21.51 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- g. B16.1 Cast-Iron Pipe Flanges and Flanged Fittings, 24, 125, 250, and 800 Pounds.
- h. B16.26 Cast Copper Alloy Fittings for Flared Copper Tubes.
- i. B18.2.1 Square and Hex Bolts and Screws.
- j. B18.2.2 Square and Hex Nuts.
- k. B36.10 Welded and Seamless Wrought Steel Pipe.
- I. B112.1 Hose Valves for Fire Protection Services.
- 3. American Society for Testing and Materials (ASTM) Standards, current edition:
 - a. A53 Standard for Welded and Seamless Steel Pipe.
 - b. A135 Standard for Electric-Resistance Welded Steel Pipe.
 - c. A795 Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
 - d. A126 Standard for Gray Iron Casting for Valves, Flanges, and Pipe Fittings.
 - e. A307 Standard for Carbon Steel Bolts and Studs.
 - f. D1869 Rubber Rings for Asbestos Cement Pipe.
 - Factory Mutual Systems (FM) Publication:
- a. Approval Guide. 5. Underwriters Lat
 - Underwriters Laboratories, Inc. (UL) Publication:
 - a. Fire Protection Equipment List (Annually with Quarterly Supplements).
 - American Water Works Association (AWWA) Standards, current editions:
 - a. B300-64 Hypochlorites.
 - b. B302-59 Liquid Chlorine.
 - c. C200-75 Steel Water Pipe 6 Inches and Larger.
 - d. C203-73 Coal-Tar Enamel Protective Coatings for Steel Water Pipe.
 - e. C207-55 Steel Pipe Flanges.
 - f. C400-75 Asbestos-Cement Pressure Pipe for Water and Other Liquids.
 - g. C500-71 Gate Valves 3 through 48 inch for Water and Other Liquids.
- 7. American Welding Society (AWS) Standards, current edition:
 - a. D10.9 Qualification of Welding Procedures and Welders for Piping and Tubing, Level AR-3.

1.7 SUBMITTALS

4.

6.

- A. Coordinate and attend a design development meeting with the Architect, precast concrete floor manufacturer, structural engineer, and Contractor to discuss precast beam sleeving locations.
- B. Shop Drawings
 - 1. Submit ten (10) copies of complete shop drawings and manufacturers' data to the owner, SEC and FM Global for all necessary reviews prior to fabrication of materials.
 - 2. Contractor shall submit complete system packages. Partial system submittals will be rejected.
 - 3. When the plans are rejected because of incomplete or incorrect information, the Contractor shall be responsible for the Engineer's extra review time and expenses beyond one resubmittal. Such extra fees shall be paid by the Contractor directly to the engineer when the resubmittal is made. The Contractor is not responsible for the engineer's review time for the first submittal and first resubmittal, or for resubmittals required because of project changes.
 - 4. The Engineer will return nine (9) prints to the Contractor, who shall then submit required prints to the Architect who shall review them and return seven (7) copies to the Contractor who will then submit to the SFM and CLVFR for final review and approval.
 - Hydraulic calculations shall include a water supply graph and hydraulic cover sheet.
 The cover sheet shall include the name and location of the calculated area, ceiling

height, occupancy, design criteria, sprinkler spacing, system type, sprinkler make, model, size, K factor and temperature rating, flow requirements, C factor used, water supply data and source of information.

- 6. Prepare shop drawings at minimum scale of 1/8" = 1'-0" for plans, and details. Show all piping, sprinklers, and hangers, type of pipe, tube connections, outlets, and occupancy of each area, including ceiling and roof heights as required by NFPA 13.
- 7. Design shall be based upon fire protection bid drawings. However, it is the responsibility of the sprinkler contractor to visit the site and prepare working drawings as required.
- C. Changes
 - 1. Make no changes in installation from layout as shown on drawings unless change is specifically approved by the Engineer. This does not include minor revisions for the purpose of coordination.
 - 2. Any changes made other than as stated above are at the Contractor's own expense and responsibility
- D. Manufacturers' Data
 - 1. Provide data from manufacturer on the following devices, including installation, maintenance, and testing procedures, dimensions, wiring diagrams, etc. Where any devices which are provided or furnished involve work by another contractor, submit additional data copies directly to that Contractor.
 - a. Sprinklers and escutcheons.
 - b. Pipe, fittings and hangers.
 - c. Control valves.
 - d. Fireproof caulk.
 - e. Waterflow devices.
 - f. Valve supervisory devices.
 - g. Bell.
 - h. Horn.
- E. As-Built Drawings
 - 1. Maintain at the site an up-to-date marked set of as-built drawings which shall be corrected and delivered to the Engineer upon completion of work.
 - 2. Upon completion, furnish the Engineer with five (5) sets of blueline prints, one (1) set of reproducible sepia prints, and one (1) set in electronic AutoCad 2007 "DWG" format of each reviewed shop drawing, revised to show "as-built" conditions.
- F. Samples
 - 1. Provide samples of each type of sprinkler covers and escutcheons.
- G. Final Inspection and Test
 - 1. The Contractor shall make arrangements with the Owner, Architect and Engineer for final inspection and witnessing of the final acceptance tests. The Owner, Architect and the Engineer will witness the final inspection.
 - 2. Perform all tests and inspections required by the referenced codes and standards, the SFM, CLVFR and the Owner.
 - 3. When the Engineer visits the job site for final inspection and tests after being advised by the Contractor that the work is complete and ready for test, if the work has not been completed or the final acceptance tests are unsatisfactory, the Contractor shall be responsible for the Engineer's extra time and expenses for reinspection and witnessing the retesting of the work. Such extra fees shall be paid by the Contractor directly to the engineer prior to rescheduling the final acceptance tests.
 - 4. The Contractor shall provide at least two (2) working days notice prior to all flushing, trip tests and hydrostatic tests. Testing will be scheduled to allow witnessing by the Owner.

- H. Upon completion of final inspections and tests, as required by appropriate NFPA Standards, submit copies of Standard Contractor's Material and Test Certificate.
- I. Operating Instructions
 - 1. Furnish five (5) copies of NFPA 25 and bound set(s) of printed operating and maintenance instructions to the Owner, and adequately instruct the Owner's maintenance personnel in proper operation and test procedures of all fire protection components provided, furnished, or installed.
- J. Spare Parts
 - 1. Provide spare sprinkler cabinets, complete with sprinklers of assorted temperature ratings of the type necessary and in use throughout the installation. Each cabinet shall be equipped with sprinklers and special sprinkler wrenches required for each type of sprinkler installed.
 - 2. Install sprinkler cabinet in each riser room.
 - 3. Confer with the Owner's representative for exact location of cabinet

1.8 GUARANTEE

A. The Contractor shall guarantee all materials and workmanship for a period of one year beginning with the date of final acceptance by the Owner. The Contractor shall be responsible during the design, installation, testing and guarantee periods for any damage caused by his (or his subcontractors') work, materials, or equipment.

1.9 BASE BID, ALTERNATES AND ALLOWANCES

- A. Base Bid
 - 1. The base bid shall be in accordance with drawings and specifications.
 - 2. The Contractor shall indicate the number of sprinklers included in the base bid.
- B. Alternates
 - 1. The Contractor shall state in his proposal any proposed contractor substitution of materials or methods of installation from that specified. These alternates shall be listed on the proposal as "Contractor Alternatives."
- C. Overtime Work
 - 1. State in bid the extra amount to be charged for each hour of overtime work for each apprentice, fitter, foreman, supervisory person, etc., that might be working on this installation.
 - 2. State the amount included in the base bid caused by anticipated overtime.
 - 3. Overtime work must be authorized in writing by the Owner's representative.

1.10 PRODUCT DELIVERY

- A. Delivery of Materials: Delivery of all materials and equipment to the job site shall be scheduled to assure compliance with the predetermined construction schedules.
- B. Storage of Materials, Equipment and Fixtures: Contractor shall be responsible for storage of materials on job site, including furnishing of any storage facilities or structures required.
- C. Handling Materials and Equipment: Contractor shall be responsible for on-site handling of materials and equipment.

1.11 QUALITY ASSURANCE

A. Testing Agency: All material shall be UL listed or FM approved.

- B. Regulatory Agencies: State and local building codes and ordinances, State, City of Las Vegas Fire & Rescue and the Owner requirements shall apply.
- C. The Contractor shall be fully experienced and licensed in all aspects of the fire protection systems herein specified.
- D. Similar materials shall be from a single manufacturer.

1.12 JOB CONDITIONS

- A. Damage: Protect all unfinished work to prevent damage and furnish protection of all surrounding areas where necessary.
- B. Leak Damage: The Contractor shall be responsible during the installation and testing periods of the sprinkler system for any damage to the work of others, to the building or its contents caused by leaks in any equipment, by unplugged or disconnected pipes or fittings, or by overflow, and shall pay for the necessary replacements or repairs to work of others damaged by such leakage. Water shall not be introduced into the system during conditions where there is danger of freezing.

1.13 EMERGENCY SERVICE

A. The Contractor shall provide emergency repair service for the sprinkler system within four hours of a request for such service by the Owner during the warranty period. This service shall be available on a 24-hour per day, seven-day per week basis.

1.14 TRAINING

A. The Contractor shall conduct two training sessions of four hours each to familiarize the facility personnel with the features, operation and maintenance of the sprinkler systems. Training sessions shall be scheduled by the Owner at a mutually agreeable time to the Contractor and the Owner.

1.15 PERMITS AND FEES

A. Obtain and pay for all permits, fees and charges required for this work.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All components shall be used in accordance with the manufacturers' recommendations and its UL-listing and/or FM-approval.
- B. The naming of manufacturers in the specifications shall not be construed as eliminating the materials, products or services of other manufacturers and suppliers providing approved equivalent items.
- C. The substitutions of materials or products other than those named in the specifications are subject to proper approval of the Owner granted in writing.

2.2 PIPE

A. Pipe shall be new, designed for 175 psi working pressure, conforming to ASTM specifications,

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and have the manufacturer's name and brand along with the applicable ASTM standard marked on each length of pipe.

- 1. Steel: Steel piping shall be galvanized, where exposed to atmosphere.
 - a. Standard Wall: Overhead pipe used inside the buildings, shall be black steel and must comply with the specifications of the American Society for Testing and Materials, ASTM A 795 for black pipe, and hot dipped zinc coated galvanized welded and seamless steel pipe for fire protection use. Galvanized pipe shall be used where exposed to atmosphere. Dimensions for all overhead pipe must be in accordance with the American Standard for Wrought Steel and Wrought Iron Pipe ANSI B36.10-1975 for pressure up to 300 psi. Schedule 40 pipe is considered "standard wall" pipe. Schedule 30 pipe is acceptable in sizes 8-inch and larger. Pipe ends shall be welded, threaded or cut grooved.
 - b. Light wall piping shall not be used.

2.3 FITTINGS

- A. Changes of direction shall be accomplished by the use of fittings suitable for use in sprinkler systems and defined in NFPA 13. Bushings shall not be used.
 - 1. Pipe shall be joined by screwed joints in accordance with ANSI B 2.1 (ANSI b 1.20.1 1983) per NFPA 13, or by welded joints in accordance with ANSI 31.1 as amended or by NFPA 13 approved mechanical fittings. Couplings may be of the rolled groove type or the mechanical locking type (push-on), and they shall be dimensionally compatible with the pipe. Pipe end preparation for the mechanical locking type couplings will be in accordance with the manufacturer's recommendations.
 - 2. Screwed fittings shall be cast iron, 125 pound class, black, and in accordance with ANSI B 16.4 or malleable iron, 150 pound class, black and in accordance with ANSI B 16.3.
 - 3. Flanged fittings shall be cast iron, short body, Class 125, black and in accordance with ANSI B 16.1. Gaskets shall be full-face of 1/8-inch minimum thickness red sheet rubber. Flange bolts shall be hexagon head machine bolts with heavy semi-finished hexagon head nuts, cadmium plated, having dimensions in accordance with ANSI B18.2.
 - 4. Weld fittings shall be steel, standard weights, black, and in accordance with ANSI B 16.9, ANSI B 16.25, ANSI B 16.5, ANSI B 16.11 and ASTM A 234.
 - 5. Push-end fittings shall not be used.
- B. Grooved fittings, valves and pipe shall be joined using rubber gasketed couplings produced by the manufacturer of the fittings and/or valves. Gaskets shall be listed for use for the appropriate application (water or dry pipe system). Victaulic "Zero-flex" or equivalent. Rigid grooved couplings shall be used where horizontal piping runs require more than two couplings per run. Rigid grooved couplings shall be used in standpipes (not in earthquake zones).

2.4 SPRINKLERS

- A. Light hazard system areas will utilize quick response, ordinary temperature sprinklers.
- B. The approximate number of sprinklers and types are shown on the drawings. If the number of sprinklers indicated in the sprinkler count summary differs from actual count on plans, the actual count shall be provided.
- C. Install intermediate and high temperature sprinklers of proper degree rating wherever necessary to meet the requirements of NFPA 13.
- D. Listed corrosion-proof sprinklers shall be installed in all areas exposed to corrosive conditions.
- E. All sprinklers shall be both UL-listed and FM-approved.

2.5 OTHER COMPONENTS

A. Valves and Devices: All sprinkler control valves, devices, valves, etc., shall be approved or listed.

B. Signs

- 1. Provide standard metal signs in accordance with NFPA 13.
- 2. Provide hydraulic information sign(s) at riser(s) in accordance with NFPA 13.
- C. Hangers
 - 1. All hanger components shall be of the approved and listed type.
 - 2. Below concrete construction, inserts, expansion cases or Phillips-type shells shall be installed to support the 1-inch through 4-inch size sprinkler piping.
 - 3. Below concrete construction, inserts shall be installed for all 5-inch, or larger piping, or, in lieu of the inserts, expansion cases, spaced not more than 10 feet apart may be installed in accordance with NFPA 13.
 - 4. Below steel deck and joist construction, use beam clamps to hang piping from top chord or joist. Do not hang piping from bottom chord, or bridging.
- D. Earthquake Bracing Steel shapes listed in NFPA 13 shall be limited to maximum length indicated. When other shapes are provided, slenderness ratio shall not exceed 200 in accordance with NFPA 13. The Contractor shall submit calculations with shop drawings indicating least radius of gyration and maximum permissible length for each shape.

2.6 UNDERGROUND PIPING

A. All underground pipe and fittings shall be pressure centrifugally cast ductile iron enameline or cement lined mechanical joint, "Tyton" joint, or approved equal. Pipe shall conform to ANSI standards.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General
 - 1. Clean-up
 - a. Maintain the premises free from accumulation of waste materials or rubbish caused by this work.
 - b. At the completion of the work, remove all surplus materials, tools, etc., and leave the premises clean.
 - 2. Safety
 - a. All work shall be performed in compliance with the Occupational Safety and Health Act of 1970 and the Construction Safety Act Standards.
 - b. Contractor shall attend all job site safety meetings.
- B. Fire Sprinkler Systems
 - Overhead Piping
 - a. All sprinkler piping, drain and test piping, fire department connection piping, etc.; exposed to weather shall be galvanized. All sprinkler piping must be substantially supported from building structure and only approved types of hangers shall be used. Sprinkler lines under ducts shall not be supported from ductwork, but shall be supported from building structure with trapeze hangers where necessary or from steel angles supporting ductwork in accordance with NFPA 13.
 - b. Sprinklers below ceilings which are on exposed piping shall be listed and

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approved regular bronze upright type, in upright position.

- c. Sprinkler piping shall be installed above drop ceilings except as noted otherwise. Install sprinkler piping in exposed areas as high as possible using necessary fittings and auxiliary drains to maintain maximum clear head room.
- d. Install sprinklers as required by NFPA 13 with regard to ducts, obstructions and partitions.
- e. Complete sprinkler installation and place in service during nonworking hours in all areas where merchandise or fixtures are stored or in place.
- f. Provide sprinkler protection before combustible contents are moved into building.
- g. Install paired flanges and numbered test blanks to provide partial protection during construction. Maintain a "test blank log," as shown on drawing, at the site during construction to assure removal of all blanks at completion of job.
- C. Drains
 - 1. Provide main drain valves at system control valves, sized in accordance with NFPA 13 and extend piping to the outdoors.
 - 2. Provide all auxiliary drains where necessary.
 - 3. Pipe all drains and auxiliary drains to locations where water drained will not damage stock, equipment, vehicles, planted areas, etc., or injure personnel. Piping to roof drains is preferred. Drains may not outlet on walks but may outlet into planters or vehicular paving. Run drains below grade through curb faces where required to avoid outletting on walks. Provide concrete splash blocks where drains outlet into planters.
 - 4. Plugs used for auxiliary drains shall be brass.
 - 5. All piping and fittings downstream of drain valve shall be galvanized.
 - 6. High and low pressure drains shall not be connected together.
- D. Electric Alarm Bells
 - 1. Provide one 110-volt 10-inch weatherproof outdoor electric alarm bell vane type D.P.D.T. waterflow switch arranged to activate for all systems.
- E. Sleeves
 - 1. Set sleeves in place for all pipes passing through floor or wall openings.
 - 2. Space between sleeve and pipe shall be filled with noncombustible packing.
 - 3. Sleeves through floors shall be watertight.
- F. Flushing Connections
 - 1. Provide flushing connections in cross-mains as specified in NFPA 13.
- G. Fire Department Connection
 - 1. Install fire department connections properly connected to piping with necessary check valve and ball drip drain connection.
 - 2. Provide standard nameplates marked "Standpipe" and "Automatic Sprinklers."
- H. Inside Control Valves
 - 1. Provide OS&Y gate valves at the supply side of the wet pipe system manifold.
 - 2. Provide post indicator valves.
 - 3. Suction control valves for fire pump shall be indicating gate valve.
 - 4. Submit complete manufacturer's data, including type, number and sizes of control valves, to the Alarm Contractor.
- I. Sprinkler Head Locations
 - 1. Suspended acoustical tile ceilings: Sprinkler heads are to be at the center of ceiling tiles in the 2-foot, 0-inch direction and at the 3/4-inch point in the 4-foot, 0-inch direction so that the sprinkler head would be centered in a 2-foot by 2-foot half portion of the ceiling tile.

- 2. Contractor shall allow for adjustments to his sprinkler heads where aesthetic placement is a concern. Locations such as at special ceilings, light coves, lighting fixtures, etc., may require relocation and the addition of sprinkler heads.
- 3. Contractor shall review and consider the location and number of vents, duct utilities, framing members, etc., in design as well as construction of the sprinkler system. Extra changes will not be granted to the Contractor to adjust the sprinkler system to fit the build. Reasonable coordination requests are expected and will be reviewed by the Architect.

3.2 WELDING

- A. No field welding of sprinkler piping shall be permitted.
- B. Headers, risers, feed mains, cross-mains, and branch lines, may be shop welded using acceptable welding fittings. Welding methods shall comply with all the requirements of AWS D10.9, "Standard for Building Service Piping," Level AR-3. Welding and torch cutting shall not be permitted as a means of installing or repairing sprinkler systems.
- C. Provide a blind flange at each end of welded header.
- D. Certify welders or braziers as being qualified for welding and/or brazing in accordance with the requirements of AWS D10.9, Level AR-3.

3.3 EARTHQUAKE PROTECTION

A. Provide listed flexible couplings in risers, feed mains and cross-mains, and approved sway bracing for risers, feed mains and cross-mains in accordance with NFPA 13.

3.4 INSPECTOR'S TEST

- A. Provide inspector's test connections, as specified in NFPA 13, at required points for testing each waterflow alarm device. Special discharge nozzle shall have same size orifice as smallest orifice sprinklers installed.
- B. Provide 1-inch sight glass if inspector's test discharge cannot be readily observed while operating valve.
- C. Pipe all inspector's test connections discharging to atmosphere to location where water drained will not damage stock, equipment, vehicles, planted areas, etc., or injure personnel.
- D. Splash blocks shall be provided where inspector's test discharge could produce damage to surroundings.
- E. All pipe and fittings downstream of inspector's test valve shall be galvanized.
- F. Consult with Owner's Representative at job for exact location of inspector's test connections and discharge locators.

3.5 SPRINKLER GUARDS

A. Provide guards on sprinklers within seven (7) feet of finished floor or wherever sprinklers may be subject to mechanical damage, such as the gym areas and locker rooms.

3.6 SPECIALTY DEVICES

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A. Installation of all specialty devices shall be in accordance with manufacturers' instructions. Where the installation of those devices require use of a torque wrench or other appliance, the Contractor shall certify that the manufacturers' instructions have been complied with.

3.7 UNDERGROUND PIPING

A. Clamp and thrust block all underground piping where required, in accordance with the requirements of NFPA 24 and local requirements

3.8 EXCAVATION AND BACKFILLING

- A. General
 - 1. Perform all excavation, including necessary shoring, and all backfilling required for the completion of work under this contract that is to be installed underground, outside, or within building walls. The arrangement of shoring shall be such as to prevent any movement of the trench banks and consequent strain on the pipes.
 - 2. Place all surplus dirt where directed by the Owner's Representative.
- B. Excavation
 - 1. Excavate to the required depth and grade to the bottom of the trench to secure the required slope.
 - 2. Rock or concrete, where encountered, shall be excavated to a minimum depth of 6 inches below bottom of pipe.
 - 3. Where mud, cinders or otherwise unstable or undesirable soil is encountered in the bottom of the trench, such soil shall be removed to firm bearing and the trench shall be backfilled with sand or bank run gravel to the proper grade and tamped to provide uniform firm support.
 - 4. When water is encountered in the trench work, furnish and operate necessary approved pumping equipment and provide approved drainage facilities to keep excavation free of water.
 - 5. The width of the trench at a point 1 foot above the top of the pipe shall not exceed fourthirds the outside diameter of the pipe, plus 8 inches.
 - 6. Piping shall be buried to a depth with not less than 3 feet, 6 inches of cover.
- C. Backfilling
 - 1. The pipe joints shall remain exposed until the pipe has been tested by the Contractor and test witnessed by the Owner's representative(s) and any local authorities having jurisdiction thereof.
 - 2. Remove all material used in shoring or trench banks before backfilling. Backfill consisting of sand or bank run gravel shall be placed to a depth of 1 foot above the top of the pipe and compacted by hand tamping. Backfill for the remainder of the trench shall consist of clean excavated material, free of rocks, stones or debris.
 - 3. The Contractor shall be responsible for the entire work, but shall engage trades specializing in backfilling.
 - 4. Submit certificates from a testing laboratory certifying that the backfilling and compaction thereof is in accordance with the requirements, before final pavement is installed.

END OF SECTION

SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Basic Mechanical Requirements applicable to Division 15 sections in addition to General requirements of Division 1.
- 1.2 RELATED DOCUMENTS:
 - A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications sections apply to all work.
- 1.3 MECHANICAL INSTALLATIONS:
 - A. The requirements of this Section apply to all the Work of Division 15.
 - B. The lateral design, including bracing and anchorage, of all mechanical units, ducts and piping shall be per structural drawings.
 - C. It is the intention of the Contract Documents including Specifications and Drawings to provide finished Work, tested and ready for operation and complete in every regard. Provide Work not shown or specified and accessories necessary to make the Work shown on the Drawings complete and ready for operation. Should there appear to be discrepancies or questions of intent in the Contract Documents, refer the matter to the Architect for his decision. The decision of the Architect is final.
 - D. Drawings are diagrammatic and are intended to convey scope of Work and to indicate general arrangement. They are not intended to show every detail including offset or fitting or every structural difficulty that may be encountered during the Work. Except as otherwise indicated, locations of items are approximate only. Exact locations necessary to secure proper conditions and results must be determined at Project Site and must be approved by the Owner. Do not scale Drawings.
 - E. Except as otherwise indicated, make only approved modifications in layout as needed to prevent conflict with other Work or for proper execution of Work.
 - F. Include Work not usually shown or specified, but necessary for proper installation and operation of a system or piece of equipment in Work.

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Proposed Products List: Include Products specified in 15000 series specifications.
- C. Submit shop drawings and product data grouped to include complete submittals of related systems, Products, and accessories in a single submittal.
- D. Mark dimensions and values in units to match those specified.

E. Submit miscellaneous items specified on the drawings but not covered in the specifications. Make no substitutions without prior approval from the Engineer.

1.5 REGULATORY REQUIREMENTS:

- A. Requirements of Regulatory Agencies:
 - 1. ASME Boiler Pressure Vessel Codes, Section VII, Pressure Vessels; Divisions 1 and 2, Section IX, Welding Qualifications.
 - 2. ASHRAE.
 - 3. UL Publications.
 - 4. ASTM.
 - 5. ANSI B31.1, "Code for Pressure Piping".
 - 6. TEMA.
 - 7. OSHA.
 - 8. EPA.
 - 9. ARI.
 - 10. NFPA.
 - 11. UMC.
 - 12. UPC.
 - 13. IBC

1.6 PROJECT/SITE CONDITIONS:

- A. Install Work in locations shown on Drawings, unless prevented by Project Conditions.
- B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes of Work specified in other Sections. Obtain permission of Engineer before proceeding.
- 1.7 DEFINITIONS:
 - A. "Provide" and "Install" means item with all appurtenances, shall be furnished and installed by contractor unless otherwise is directed in the drawings.

PART 2 - PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT:
 - A. Provide standard products of a manufacturer regularly engaged in manufacturer of the indicated product. Where more than one unit is required of any product, provide products by the same manufacturer, except where otherwise indicated. Provide products in accordance with manufacturer's recommendations. In the event of a conflict between plans and specifications and the manufacturer's recommendations, notify the Architect immediately.
 - B. Deliver products in the manufacturer's original unopened, labeled containers and adequately protect against moisture, tampering or damage from improper handling or storage. Do not deliver materials to the job before they are ready for installation, unless adequate security is provided.
 - C. Owner may require removal from the premises of such material or Work that in his opinion is not in accordance with Contract Documents. He may also require substitution, without delay, of unsatisfactory Work.
 - D. Repair and refinish work damaged by the Work of this Division, to Owner's satisfaction. Obtain finishing materials from equipment manufacturer.

2.2 MATERIALS:

A. Electric Motors

- 1. General
 - All fan and pump motors except two-speed motors 5 HP and larger shall be of the premium efficiency type. Guaranteed minimum full load efficiencies shall be certified in accordance with Institute of Electrical and Electronic Engineers (IEEE) Standard 112 Test Method B, National Electrical Manufacturing Association (NEMA) MG-1-12.53a.
 - b. Electric motors shall be open drip-proof, continuous duty, 40°C. rise type with Class "B" insulation, NEMA design B unless specified otherwise. Motors shall be of premium efficiency type, and 1.15 service factor.
 - c. Three phase motors shall have regreasable ball bearings.
 - d. Motors shall have a power factor of 0.9.
- 2. Motors installed in outdoor locations shall be totally enclosed, fan cooled and continuous duty rating at 55°C., and 1.00 service factor.
- 3. Where motor is an integral part of equipment, motor manufacturer shall be as recommended by the equipment manufacturer.
- 4. Motors shall in all cases have adequate starting torque to bring driven equipment up to rated speed in a time interval acceptable to the Architect.
- 5. Motors greater than 1/2 HP shall be 460 volt, 3 phase, 60 Hertz of NEMA design B, NEC Code F or lower in-rush.
- 6. Motors 1/2 HP and smaller shall be 115 volt, single phase, 60 Hertz of NEMA design B, Code F or lower with internal thermal protection.
- 7. Control Panels: Where specified, panels shall be a NEMA 3R enclosure prewired for one point feeder supply connection and shall include the following:
 - a. Across-the-line magnetic type starter with overload protection and HOA switches.
 - b. Fused switches with dual element fuses.
 - c. Control transformer with fused primary and fused secondary protection.

2.3 COUPLINGS:

- A. Couplings for direct drive equipment shall be flexible, self-aligning, non-lubricating type, rated at least 125% of motor rated horsepower.
- B. Coupling halves shall be keyed and locked on shafts.
- C. Manufacturer: Couplings shall be Fast's Standard, or John E. Lisee Pump, Inc.

2.4 BELT DRIVES:

- A. General
 - 1. Belt drives shall be V-belt type with appropriate sheaves.
 - 2. Minimum of two belts per drive.
 - 3. Motors 15 HP and smaller shall be provided with variable pitch sheaves and installed on motor slide rails.
 - 4. Motors 20 HP and larger shall have nonadjustable drive sheave and be installed on motor slide rails.
 - 5. After air balance is completed and air balance has been accepted by the Engineer/ Architect change each variable pitch sheave to fixed pitch sheave.
 - 6. Manufacturer: Sheaves and belts shall be Browning, Dodge, or Gates.
- B. Sheaves
 - 1. Sheaves shall be cast iron, machined and balanced.
 - 2. Variable pitch sheaves shall be selected for midpoint of equipment operating capacity.

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- 3. Sheaves shall be keyed and located on shafts, with Allen head set screws. On fractional horsepower motors on NEMA frame size 48, smaller sheaves may be secured to shaft with set screws only.
- C. Ratings
 - 1. Belt drives for one and two cylinder reciprocating compressors: Minimum horsepower rating, at design speed, of 1.7 times the motor nameplate horsepower rating.
 - 2. All other belt drives: On each two belts drive, each belt shall be rated for motor nameplate horsepower rating. On three belt or greater, drive shall be rated for 150% of motor nameplate horsepower rating.

2.5 GUARDS:

- A. General: All rotating elements on equipment shall have protective devices in accordance with the CCR Title 8, Division of Industrial Safety and General Industry Safety Orders and OSHA requirements.
- B. Coupling guards shall completely enclose the rotating coupling and shall be constructed of heavy gage steel in accordance with OSHA requirements.
- C. Belt Guards
 - 1. Guards shall totally enclose the belts and sheaves. Guards shall be fabricated of galvanized expanded metal sides, solid galvanized steel band and adequately sized galvanized angle iron frame.
 - 2. Adequate room for belt adjustments shall be provided.
 - 3. Tachometer holes with covers shall be provided for both sheaves.

2.6 FIRE STOPPING MATERIALS:

A. Provide fire stopping in accordance with products specified in Division 7 for installation as required for mechanical and plumbing penetration through fire rated walls and slabs.

2.7 ACCESS PANELS:

- A. Do not place products including valves, traps, controls, unions, dampers, coils, air distribution boxes, cleanouts, junction boxes, pull boxes, and expansion joints at locations that will be inaccessible after construction is completed. Maintain accessibility for all components in systems. Panel shall be sized for proper service not less than twelve inches (12") x twelve inches (12"). Submit Shop Drawings for approval.
- B. Provide access doors complying with Division 8 for items located above finished ceilings, ceiling breaks or extensions behind finished walls or below finished floor.

2.8 SLEEVES:

- A. Provide sleeves in locations where pipes or conduit pass through floors, walls, partitions, structural members and roof. Do not make openings that impair strength, function or esthetics of the Work. Notify the Architect and Structural Engineer prior to any cutting Work. All sleeves shall be compatible with piping material that passes through them.
- B. Provide pipes passing through floors, walls, partitions, roofs or concrete beams with sleeves having internal diameter 1 inch larger than outside diameter of pipe, and insulation except for sleeves connecting buildings that shall be 1-1/2 inch larger.
- C. In sleeves passing through firewalls or floors, or lightproof or soundproof walls, floors and partitions, pack space between sleeve and pipe or insulation with non-shrink grout, ceramic

fiber or other approved sealant materials. Install rigid calcium silicate insert on insulated pipe. Approved prefabricated assemblies, Pipe Shields or equal, are acceptable.

- D. Sleeves through outside walls or through slab-on-grade, except soil pipe through slab: Provide Schedule 40 black steel pipe with 150 lb. black steel slip on welding flange welded at center of sleeve and painted with one coat of bitumastic paint inside and outside. The space between sleeve and pipe shall be packed with oakum to within 2-inches of each face of wall. The remaining space shall be packed and sealed watertight with waterproof compound. Fabricated seals, Thunderline link-Seal or equal, are acceptable. This paragraph does not apply for sleeves connecting buildings.
- E. Sleeves through masonry or concrete floors or interior masonry or concrete walls. Provide Schedule 40 black steel pipe, set flush with finished wall or ceiling surfaces, but extending 1-inch above finished floors.
- F. Sleeves passing through roof construction: Extend minimum 8-inches above roof, flash and sealed water-tight with safe support of conduit and equipment furnished under each division.
- G. Sleeves through interior walls other than masonry or concrete: Provide 12 gauge galvanized sheet steel, set flush with finished surfaces of partitions.
- H. Sleeves passing through membrane waterproofing or lead safe: Provide 16 ounce soft sheet copper or four-pound lead flashing extending 12-inches beyond sleeves in all directions; secure to waterproofing or lead safe, turn down flashing into space between pipe and sleeve; insert oakum gasket, pour lead, caulk water-tight.
- I. Un-insulated copper pipe through ferrous sleeves or in contact with cement or concrete: Wrap pipe with two layers of heavy plastic protective tape. Finish wrapping flush with sleeve ends.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILL:

- A. General: Excavation and backfill, if required to install the Work specified in this Division shall be performed in compliance with the following requirements.
- B. Excavation: Bury piping outside the building to a depth of not less than 2'-6" below finish grade unless noted otherwise.
- C. Backfilling: Do not backfill until final inspection and approval for the piping installation.

3.2 PROTECTION, CARE AND CLEANING:

- A. Protection: Protect all finished parts of the materials and equipment against physical damage from whatever cause during the progress of this work and until completion.
- B. Care: During construction, cap all lines and equipment nozzles so as to prevent the entrance of sand and dirt. Protect equipment against moisture, plaster, cement, paint and other work by covering it with polyethylene sheets.
- C. Cleaning: After installation has been completed, clean all systems as follows:
 - 1. Ductwork, Piping and Equipment to be insulated: Clean exterior to remove rust, plaster, cement and dirt before insulation is applied.
 - 2. Ductwork, Piping and Equipment to be painted: Clean exterior of piping and equipment exposed in completed structure, removing rust, plaster, cement and dirt by wire

brushing. Remove grease, oil and similar materials by wiping with clean rags and suitable solvents. Any piping not detailed to be painted shall be primed with approved primer after wire brushing.

3. Motors, pumps and other items with factory finish: Remove grease and oil, and leave surfaces clean and polished.

3.3 EXAMINATION AND EXISTING WORK:

- A. Examine Specifications, Drawings and the site and become familiar with conditions affecting Work, and consult and cooperate with contractors, subcontractors, sub-subcontractors and installers. Owner reserves the right to determine space priority in the event of interferences.
- B. If Work is installed without coordinating with others, and such installation interferes with their installation, make changes necessary to correct the conditions at no cost to Owner.
- C. Protect existing services including water, gas, sewer, and electric against damage. If Work makes temporary shutdowns of services unavoidable, consult with Owner as to dates, procedures, and estimated duration of shutdown period at least ten working days in advance of the date that the Work is to be performed.
- D. Arrange Work for continuous performance to assure that existing operating services will be shut down only during the time required to make necessary connections. If a system cannot shut down, install temporary bypasses or jumpers until connections are complete.
- E. If existing active utility services are encountered which require relocation, make request to proper authorities for determination of procedures. Properly terminate existing services to be abandoned in conformance with requirements of authorities having jurisdiction and utilities.
- F. New equipment shall remain the property of the Owner and shall be stored on site.
- G. Where connections or disruptions are made to existing systems, reactivate, refill and recharge all components and restore systems to the same operating conditions prior to the time of disruption.

3.4 LUBRICATION:

- A. Upon Completion of the Work and before turning over to the Owner, clean and lubricate all bearings except sealed and permanently lubricated bearings.
- B. Use only lubricant recommended by the manufacturer and as listed in the Service Manual.
- C. Maintain lubrication of all mechanical equipment specified in this Division until Work is accepted by the Architect.

3.5 PAINTING:

A. Painting is specified in Division 9.

3.6 CUTTING AND PATCHING:

- A. Cut completed construction Work with specific permission of the Owner. Do not cut reinforcing steel without specific permission of Owner and Structural Engineer.
- B. Provide sleeves, caps, plates, escutcheons, flashing, etc., required to fill or close the openings. Provide final grouting, concrete, asphalt, masonry, painting and other materials as required.

Make repairs in like and kind for exact patching or surfaces and finishes.

C. Where cutting and patching occurs in streets, sidewalks, alleys and the like, cooperate fully with Owner and municipal or other government bodies.

3.7 CONCRETE WORK:

- A. General: Refer to Division 3.
- B. Housekeeping Pads and Isolation Bases
 - 1. Furnish dimensional drawings for all required bases and pads and location thereof.
 - 2. Furnish all embedded anchor bolts and sleeving and verify installation of same.

3.8 EQUIPMENT BASES AND SUPPORTS:

- A. Provide housekeeping pads of concrete, minimum 5 inches thick and extending 6 inches beyond supported equipment Refer to Div. 3.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members or Steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.
- E. The lateral design, including bracing and anchorage, of all mechanical units shall be per structural drawings.

3.9 FLASHING:

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked one inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash, and seal.
- C. Flash floor drains in floors with topping over finished areas, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device. Seal drains watertight to adjacent materials.
- D. Provide acoustical sleeves around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
- E. Provide curbs for mechanical roof installations 16 inches minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints. Curbs shall be provided by Division 7 where requested on the drawings. All other curbs shall be field fabricated.
- F. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.10 SLEEVES:

- G. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- H. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- I. Extend sleeves through floors one inch above finished floor level. Caulk sleeves.
- J. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- K. Install one piece chrome plated brass escutcheons at finished surfaces.

3.10 OPERATIONAL TESTS:

- A. A testing and balancing firm will be employed under a separate contract to carry out full acceptance tests.
- B. All equipment shall be provided ready for acceptance tests to be carried out. Any changes which are required to enable equipment to perform to the requirements of the design shall be provided under Division 15. This shall include but not be limited to items such as pulleys, sheaves, and shim adjustment and impeller changes.
- C. Systems shall be operable and capable of maintaining continuous uninterrupted operational service during the operating and demonstration periods of operation.
- D. All rotating equipment shall be in dynamic balance and alignment.
- E. Make all required adjustments to or replacement of the pulleys, belts, drives, sheaves, dampers, balancing valve, motors or the addition of dampers, balancing valves as required for proper equipment and system operation to achieve the capacities specified or scheduled on the Drawings as recommended by the testing agency, at no additional cost to the Owner.

3.11 SERVICES:

- A. General: Perform service on all Mechanical Work after original installation for a period of one year of completion including oiling and greasing, adjustments, cleaning, packing of seals, and other items as recommended by equipment manufacturer in the maintenance manual.
- B. Air Filters
 - 1. Do not operate air-moving equipment having air filters unless temporary filters, of similar rating to specified, are in place to protect the Mechanical Work.
 - 2. Replace these temporary filters with specified filters before final test and balance work is begun as necessary for accurate readings. After completing the testing and balancing work, replace filters with new filter media as specified.
- C. Strainers: Remove, clean and reinstall each strainer screen as specified below after systems have been flushed as specified in this section.
 - 1. Clean each strainer screen after all adjustments have been made and system has operated a minimum of 24 hours, but before final test and balancing operation is started.
 - 2. Clean each strainer screen again, after final test and balancing operation and before completion of the Project.
 - 3. Remove flushing screens if provided, set next to pumps.
- D. Purge air from water systems after each servicing. Protect furnishings and finishes during each

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servicing operation and repair or replace to original condition those damaged as a result of servicing.

- E. Replace insulation removed or damaged after each operation. Use insulation as specified in Section 15250.
- F. Put system in full operating condition.
- G. Provide labor, materials, instruments and power required for testing under respective Sections for Work.
- H. Test shall be performed to satisfaction of Owner and regulating authority having jurisdiction. Submit to Owner written certificates that tests have been performed in accordance with Specification requirements.
- I. Pressure test piping before connection to equipment. No piping equipment or accessories shall be subjected to pressures exceeding their rating.
- J. Repair or replace defective Work and repeat tests until systems, and component parts comply with requirements of Contract Documents and authorities having jurisdiction. Damages resulting from tests shall be repaired and damaged material shall be replaced.
- K. Test equipment and systems through the full range of parameters specified and shown on the Drawings. Tests shall be performed on individual equipment, systems and their controls. Whenever the equipment or system under test is inter-related with, and depends upon the operation of other equipment or systems and their controls for proper operation, functioning, and performance, test equipment or systems with related equipment or systems shall be operating simultaneously
- L. Do not close up, furr- in, or cover before testing and Inspection by Owner/Architect.
- M. Test systems as specified under applicable Sections. Duration of tests shall be determined by the authority having jurisdiction and in no case less than the time specified.
- N. Drain water used for testing from the system after tests are complete. Repair or replace any damages caused by freezing of water left in system.
- O. Make all required repairs to or replacement of the pulleys, belts, drives, sheaves, dampers, balancing valves, motors or the addition of dampers, balancing valves as required for proper equipment and system operation to achieve the specified or scheduled on drawings capacities as recommended by the testing agency, at no additional cost to the Owner.

3.12 EMERGENCY REPAIRS:

- A. Provide the OWNER with a contact name and 24 hour telephone number for emergency repairs.
- 3.13 INSTRUCTIONS FOR OWNER'S PERSONNEL:
 - A. Prior to acceptance of Work and during time designated by Owner, provide necessary qualified personnel to operate each system for period of five consecutive full working days.
 - B. During operating period, fully instruct Owner's personnel in complete operation, adjustment and maintenance of each respective installation as specified in each respective Section.

C. The Contractor shall provide videotaped instructions to the Owner in addition to each training session.

3.14 PROTECTION AND CLEANING:

- A. The Work of each Section includes removing tools, scaffolding, surplus materials, barricades, temporary walks, debris and rubbish from the Project promptly upon completion of that portion of the Work. Leave the area of operations completely clean and free of these items. No food, smoking or chewing tobacco in building confines.
- B. During the course of construction, cap all ducts, pipe and electrical conduit in approved manner to ensure adequate protection against entrance of foreign substances.
- C. Disconnect, clean and reconnect, whenever necessary, to located and remove obstructions from any system. Repair or replace any Work damaged in the course of removing said obstructions at no additional cost to the Owner.
- D. Protect all finished parts of the materials and equipment against physical damage from whatever cause during the progress of this work and until completion.
- E. During construction, cap all lines and equipment nozzles so as to prevent the entrance of sand and dirt. Protect equipment against moisture, plaster, cement, paint and other work by covering it with polyethylene sheets.
- F. Cleaning: After installation has been completed, clean all systems as follows:
 - 1. Ductwork, Piping and Equipment to be insulated: Clean exterior to remove rust, plaster, cement and dirt before insulation is applied.
 - 2. Ductwork, Piping and Equipment to be painted: Clean exterior of piping and equipment exposed in completed structure, removing rust, plaster, cement and dirt by wire brushing. Remove grease, oil and similar materials by wiping with clean rags and suitable solvents.
 - 3. Motors, pumps and other items with factory finish: Remove grease and oil, and leave surfaces clean and polished.

3.15 EQUIPMENT AND MATERIAL SUBSTITUTIONS:

A. The first named manufacturer listed for materials in this Division is the basis of design. The other named manufacturers may be deemed acceptable substitutions providing that the contract requirements are satisfied and full substitution information is submitted within 30 days of contract award.

END OF SECTION

SECTION 15060

PIPE AND PIPE FITTINGS

PART 1 - GENERAL

- 1.1 WORK DESCRIPTION:
 - A. Provide all piping and pipe fittings necessary for complete installation as indicated on the Drawings and as specified.

1.2 RELATED WORK:

- A. Division 8 Access Doors.
- B. Division 9 Painting.
- C. Section 15190 Mechanical Identification.
- D. Section 15240 Vibration Isolation and Seismic Control.
- E. Section 15250 Mechanical Insulation.
- F. Section 15510 Hydronic Piping.

1.3 REFERENCES:

- A. ASME Boiler and Pressure Vessel Codes, SEC 9 Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brasing Operators.
- B. ASME B16.3 Malleable Iron Threaded Fittings Class 50 and 300.
- C. ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- D. ASTM B32 Solder Metal.
- E. ASTM B88 Seamless Copper Water Tube.

1.4 QUALITY ASSURANCE:

A. Conform to ASME B31.9 code for installation of piping system.

1.5 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Submit manufacturer's technical product data and installation instructions for each type of pipe, pipefittings, and solder and flux.
- C. Piping schedule showing manufacturer, pipe weight, fitting type, and joint type for each piping system.
- 1.6 DELIVERY STORAGE AND HANDLING:

- A. Deliver, store, protect and handle products to site under provisions of Division 1.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. All piping and accessories shall be manufactured in the U.S.A.
- B. Black Steel Pipe and Fittings for Steel Pipe

1.	Standard Weight Steel Pipe
1.	Standard Weight Steel Pipe

Diameter Inches	Manufacturing Methods	Wall Thickness	ASTM Grade	Spec
1/8 thru 2	Threaded	Schedule 40	A-53	A or B
2 1/2 thru 10	Welded or Seamless	Schedule 40	A-53	A or B

C. Unions and Flanges

- 1. Provide 150 psig. class malleable iron with bronze or brass to iron ground joints for 2 inch and smaller pipes.
- 2. Provide unions over 2 inches of forged steel 150 psig. class raised face weld neck or slip-on flanges conforming to ASTM A 181 and ANSI B 16.5.
- D. Ductile Iron Pipe and Fittings for Ductile Iron Pipe
 - 1. Cast Iron Drainage Pipe and Fittings: Joints shall be made with hubless pipe and fittings, using a neoprene sealing sleeve and stainless steel clamp and shield assembly.
 - a. Minimum weight in pounds for single hub 5 foot lengths shall be as follows:

Size, Inches	Service Weight, Pounds
2	20
3	30
4	40
5	55
6	65
8	100
10	145

- b. Furnish fittings, specials, and miscellaneous lengths in the same thickness class as herein specified for 5 foot lengths.
- E. Copper Tube and Fittings for Copper Tube
 - 1. Copper Water Tube and Fittings

- Furnish seamless copper water tube conforming to the requirements of ASTM B 88 in weight K or L, and temper annealed or drawn as specified. Comply with FS WW-T-799, for refrigeration service.
- Solder and Flux for Water Piping: High temperature solder with a flow point above 1100 degrees F. shall be used for joining copper tubing and fittings. The flux shall be as recommended by the manufacturer of the solder. One of the following solders, or equal, may be used: Silfos - 1300 degrees F, Flow Point; Easy-Flo #3 -1270 degrees F, Flow Point, or equal.
- F. Fittings for Copper Water Tube
 - 1. Wrought Copper Fittings: Furnish wrought pressure solder joint fittings, pressure fittings conforming in all respects to ANSI B16.22.
 - 2. Cast Bronze Fittings: Furnish cast bronze solder joints pressure fittings conforming in all respects to ANSI B16.18 and same weight as pipe.
 - 3. Provide Brazolets of high silicon bronze conforming to ASTM B283 in sizes 2 inches and smaller, and conforming to MIL STD B-16541 in sizes 2-1/2 inches and larger.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Piping and Fittings: Ream all pipes to full inside diameter after cutting and clean before erection.

3.2 INSTALLATION:

- A. General
 - 1. Run all piping as direct as possible, and conceal piping in finished rooms unless shown or specified otherwise. Arrange pipe lines to give ample room for the pipe insulation specified in Section 15250.
 - 2. Make tee connections with standard tee fittings for full size branches. For reduction branches, when branch line is a minimum of 2 pipe sizes smaller than main line, use reducing tees or weldolets and threadolets for steel pipe and brazolets for copper pipe.
 - 3. Make screwed joints with teflon tape or a pipe joining compound, recommended by the pipe manufacturer, applied to the male threads only. Welded joints to be welded as set forth in the standard manual of Pipe Welding of the Heating, Piping, and Air Conditioning Contractors Association.
 - 4. Make joints in copper pipework with solder joints made with 95-5 tin-antimony solder.
- B. Installation Polyvinyl Chloride Pressure Pipe
 - 1. Install polyvinyl chloride pressure pipe in accordance with the AWWA Manual M23 and the manufacturer's recommendations except as otherwise provided herein or shown.
 - 2. Prior to installation, all polyvinyl chloride pressure pipe, couplings, and rubber rings shall be inspected by the Contractor for damage and defects in material and workmanship. All damaged of defective materials shall be rejected and removed from the job site, by the Contractor at no expense to the Owner.
 - 3. Polyvinyl chloride pressure pipe showing signs of physical damage or unacceptable ultraviolet exposure as determined through visual inspection by the Owner may be rejected and then must be removed from the job site.
 - a. Material so rejected will be approved for installation, if the Contractor at his sole cost and expense provides the Owner documented test results prepared by a certified testing laboratory showing the rejected pipe to be in conformance with AWWA C900.
 - 4. Use the manufacturer's recommended pipe lubricant when making pipe connections.
 - a. Lubricate only the spigot end up, including the reference mark.

- The reference mark on the spigot end must be flush with the end of the bell. Follow AVWVA Manual M23 and the manufacturers recommendations b.
- C.

3.3 ADJUSTMENT AND CLEANING:

- After piping is erected, flush all piping before running pumps or sterilizing the potable water Α. system.
- Β. Clean each system by passing cleaning fluids through pipework. Isolate previously cleaned equipment from the system and do not subject to cleaning fluids.
- C. Flush systems completely after cleaning.

END OF SECTION

SECTION 15100

VALVES

PART 1 - GENERAL

1.1 WORK DESCRIPTION:

A. Provide and install all valves within the building as indicated on the Drawings and as specified.

1.2 RELATED WORK

A. Section 15510 – Hydronic Piping

1.3 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Furnish shop drawings, product data for valves.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. General: Unless otherwise indicated, all valves of all types installed in connection with mechanical piping shall comply with the following:
 - 1. Provide one make throughout the Project manufactured by Stockham, Crane, Nibco (USA), unless otherwise indicated.
 - 2. Pack all stems in conformance to ANSI B16.34.
 - 3. All valves 2 inches and smaller to have bronze bodies and to be threaded.
 - 4. All valves 2-1/2 inches and larger shall be bronze body mounted (BBM) type and shall be flanged.
 - 5. Wheel handles to be non-heating style cast from malleable iron ASTM A 197.
 - 6. Mark each valve at the factory with the following minimum information, engraved, stamped, or cast on each valve or metal tag permanently attached to the valve.
 - a. Manufacturer's Name.
 - b. Catalog or Figure No.
 - c. Size and Pressure Class.
 - d. Arrows shall indicate direction of flow on check, globe, angle, non return, and eccentric plug valves.
 - e. UL approved valves and shall bear the UL label.
 - 7. Unless identified on the Drawings, each valve shall be the same size as the pipe in which it is installed.
 - 8. Provide extension necks or stems on insulated valves to ensure the valve wheel and handle is exposed.
 - 9. All valves shall be "U.S." manufactured.

2.2 BALL VALVES:

- A. Screwed two inches (2") and smaller, cast bronze body, 125 psi wog, 150 psi .
- B. Valves shall include reinforced Teflon packing ring, thrust-seal, body seals and seats.

- C. Balls shall be stainless steel; with full size ports, 2 piece.
- D. Quarter turn on-off, adjustable packing gland and internally inserted stem.
- E. 2-1/2 and Larger: Nibco 150 psi. Flanged ball valve, full size ports, 3 piece bronze body and 316 S.S. ball and stem with Teflon seat.

2.3 CHECK VALVES:

- A. Size, 2 Inches and Smaller
 - 1. Provide swing check valves designed for 200 psig non shock water, oil, and gas working pressures. Regrinding valve seats not to require removal of valve from line. Provide screwed caps, renewable side plugs, hinges, and bronze discs. Valves shall operate equally well in the vertical or horizontal position.
 - 2. Materials: Body made from bronze conforming to ASTM B 61 or B 62. Cap, disc, and hinge made from bronze conforming to ASTM B 61 or B62, screwed ends.
 - 3. Manufacturers: Crane 1303, Stockham B-321.
- B. Size, 2-1/2 Inches and Larger
 - Provide swing check valves designed for 200 psi non shock water, oil, and gas working pressures. Regrinding valve seats not to require removal of valve from line. Provide screwed caps, renewable side plugs, hinges, and bronze discs. Valves shall operate equally well in the vertical or horizontal position.
 - Materials: Body made from high grade iron conforming to ASTM A 126 Class
 B. Cap, disc, and hinge made from bronze conforming to ASTM B 61 or B 62, screwed ends.
 - b. Manufacturers: Crane 38.

2.4 ECCENTRIC PLUG VALVES (BALANCING VALVE)

- A. Provide non lubricated eccentric plug style valves designed for minimum pressure loss in the wide open position. Equip with adjustable opening stops for balancing. Resilient plug facing shall be capable of continuous bubble tight service in water at 250 degrees F.
 - 1. Furnish valves, sizes 5 inches and smaller designed for 150 psig and valves 6 inches and larger for 125 psig, non-shock water working pressures at 250 degrees F.
 - 2. Provide with permanently lubricated corrosion resistant bushings in top and bottom bearings.
 - 3. Provide bodies tapped with a pipe connection on downstream side of seat for pressure gage connection. Equip valves 4 inches and larger with gear actuators. All gearing shall be enclosed, manufactured for running in oil, and the actuator to be submersible with seals provided on all shafts to prevent entry of water into the actuator. Provide all shaft bearings with permanently lubricated bronze bearing bushings. Actuator to clearly indicate valve position and an adjustable stop shall be provided to set closing torque. Ensure valve packing and adjustment is accessible without disassembly of the actuator.
- B. Manufacturers General
 - 1. DeZurik Valves: Provide with cast iron bodies, bonnets and plugs conforming to ASTM A 126, C lass B. Face plugs with De Zurik's "RS 55."
 - 2. Homestead Valves: Furnish Homestead "ballcentric" valves with nickel iron body, cap, and plug, having 1 to 1-1/2 percent nickel content and an average tensile strength of 34,000 psi. Plugs shall be faced with ethylene-propylene terpolymer (EPT).
- C. Manufacturer, by Size and Service
 - 1. Sizes, 2 Inches and Smaller: De Zurik No. 1185, Homestead No. 1512, with permanently attached lever operators.
 - 2. Sizes, 2-1/2 Inches Through 3 Inches: DeZurik No. 118F, Homestead No. 1522, with

permanently attached lever operators.

2.5 **BUTTERFLY VALVE:**

- General: 2 1/2 inch through 12 inch furnish valves designed for 200 psig non shock and 250 Α. degrees F. water service.
- Β. Valves shall conform to ASTM A-126 Class B cast iron.
- C. Valves shall be lug type drilled and tapped for dead end service. 1.
 - Materials of construction shall be:
 - Body -High Grade Iron. a.
 - Disc Aluminum Bronze. b.
 - Stem 300 series stainless steel if exposed to flowing media, 400 series c. stainless or allow steel phosphate coated, if not exposed to flowing media.
 - Seat Ethylene Propylene Diene Monomer (EPDM). d.
 - Operator shall be a 10-position lever lock for sizes 2-6 inches with a totally enclosed 2. weatherproof acme screw gear actuator for 8 inches and larger infinite adjustment; memory stop options shall be provided.
- D. Manufacturers
 - 2 1/2 to 6 inch: Stockham LG-512-DS3-E, Crane 44-FXZ-TL. 1
 - 2. 8 inch and larger: Stockham LG-522-DS3-B, Crane 21-FRB0-G.

2.6 NATURAL GAS SYSTEM:

- Α. Acceptable Manufacturer's (U.S. Manufactured only):
 - Gas Valves: Stockham, Homestead, Nordstrom, Crane, Rockwell, Mueller, Rockford-1. Eclipse, Lunkenheimer.
- Β. Shut-off Valves:
 - 2" and smaller: Bronze or ferrous body, threaded ends, bronze or ferrous tapered plug. 1 150 psi W.O.G., for use as natural gas shut-off.
 - 2. 2-1/2" through 4": Cast iron body, flanged ends, bronze bearings, electroless nickel plated cast iron plug with Hycar resilient plug seal, Buna-N stem seal packing, lever actuator, 175 psi W.O.G., for use as natural gas shut-off.
- C. Provide plug valves for all installation.

PART 3 - EXECUTION

3.1 INSTALLATION:

- Α. Install all valves in accordance with manufacturer's printed instructions and as indicated on Drawings.
- Β. Do not install valves upside down.
- 3.2 ADJUSTMENT AND CLEANING:
 - Adjust, pack, and replace valves and stops as may be required to eliminate leaks and to meet Α. flow requirements of ASME B31.

END OF SECTION

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SECTION 15120

PIPING SPECIALTIES

PART 1 - GENERAL

- 1.1 WORK DESCRIPTION:
 - A. Provide piping specialties as indicated on the Drawings and as specified.

1.2 RELATED WORK

A. Section 15510 - Hydronic Piping.

1.3 REFERENCES:

A. ASME - Boilers and Pressure Vessel Codes, SEC 8-D-Rules for Construction of Pressure Vessels.

1.4 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
- C. Submit inspection certificates for pressure vessels from authority having jurisdiction
- D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- E. The following list includes the required shop drawings that shall be submitted:
 - 1. Vents
 - 2. Strainers
 - 3. Vacuum Breakers
 - 4. Air Separator
 - 5. Side Stream Filter
 - 6. Expansion Tanks

PART 2 - PRODUCTS

2.1 MATERIALS

- A. System Specialties
 - 1. Air Vents
 - 2. Install air vents on all points required for efficient operation of system.
 - 3. Install automatic vents as shown in the drawings and where exposed to view.
 - 4. The discharge from all automatic air vents shall be discharged above the nearest floor sink where located in mechanical rooms or exposed areas.
 - 5. The discharge from all automatic air vents in concealed areas shall run to within 12inches of accessible ceilings or 12- inches of access panels in fixed ceilings. Use 1/4inch copper water tube ASTM B88, Type K for discharge line.

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PIPING SPECIALTIES

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- 6. Automatic Vents: Hoffman No. 79, Bell and Gossett No. 87, or equal.
- 7. Provide air chambers at all high points and intermediate high points in piping with air vent cocks fully accessible. Provide air chambers with diameters same size as pipe and a minimum of 2 inches long except provide same length as diameter for pipes larger than 2 inches. When air vent cocks on air chambers are not fully accessible, extend cocks with 1/4 inch copper water tube ASTM B 88, Type K.
- 8. Strainers
 - a. Provide "y" type strainers throughout the job unless specifically noted otherwise. Provide bronze or cast iron body strainers.
 - b. "Y" Strainers. Provide one manufacturer throughout the Project.
 - c. Strainers shall be equipped with blowoff valves, with screen sizes as follows:

<u>Size,</u> Service	<u>Straining</u> Inches <u>Medium</u>	Screen Size
Water	1/4 to 2	1/16
	2-1/2 to 4	1/16
High Temp.	1/4 to 2	20 mesh
Hot Water	2-1/2 up	3/64

- d. Strainers General: Use 150 psig pressure class.
- e. Two inches and smaller. Furnish screwed ends, screwed bronze cap and gasket in sizes 1-1/2-inch and smaller and with a bolted cap on 2-inch size. Screens on water service to be made of monel or stainless steel. Provide iron body strainers Mueller No. 251 FBC or 251 BC, Crane 988-1/2, or equal, except provide bronze strainers in all copper piping Mueller No. 351, Hoffman 420, or equal.
- f. Two and one half inches and up. Furnish flanged ends, bolted gap and gasket, stainless steel or monel screen. Provide cast iron body in steel piping and bronze body in copper piping.

g. Provide blow off valves on all strainers, with hose connection, cap and chain.

9. Vacuum Breakers:

a.

- Watts Regulator Company, Model No. 288, Sloan Valve Company, No. V-300A, or equal with bronze body chrome plated in finished areas.
- 10. Insulating Couplings:
 - a. Provide for the appropriate sizes of cast iron couplings, cast iron fittings or cast iron flanges at all interconnections between piping systems of dissimilar material and at all connections of piping systems to equipment where piping and equipment are of dissimilar materials.
- 11. Expansion Tanks:
 - a. Construction: Closed, welded steel, tested and stamped in accordance with Section 8D of ANSI/ASME Code, 125 psi rating, cleaned, prime coated, and supplied with steel support saddles, with tappings for installation of accessories. Tank shall be precharged with replaceable heavy duty Butyl Rubber Diaphragm.
 - b. Manufacturers: Taco, Bell & Gossett or Equal.
- 12. Air Separator
 - a. Provide vortex action in tank of separator to remove air bubbles from circulating water. Separator to be in accordance with ASME Boiler and Pressure Vessel Code Section VIII, Division 1, 125 psig working pressure.
 - Vertical steel tank, tangential inlet and outlet, stainless steel collector tube with 5/32" diameter perforations and 63% open area designed to direct accumulated air to the compression tank via an NPT vent connection at the top of the tank. Connection sizes shall be same size as pipe. Provide a bronze, float operated air elimination valve with the separator.
 - c. Manufacturer: Taco, Bell & Gossett, or equal.
 - d. Provide one separator for each chilled and hot water systems. Anchor each

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tank to structure above.

- Side Stream Filter
 - a. As specified in drawings.

PART 3 - EXECUTION

2.

3.1 INSTALLATION

- A. Provide valves at each piece of equipment to provide for isolation of the equipment from its connected system. Locate strainers and valves as necessary to provide easy isolation and cleaning of strainers.
- B. Provide unions adjacent to each screwed type valve and on the outlet side of the valve. Drain all air vents to a floor sink or floor drain.
- C. Provide all piping accessories required for complete installation of Mechanical Work
- D. Install strainers ahead of all automatic valves and elsewhere as indicated on the Drawings. Provide a ball valve with hose connection, cap and chain in the blowoff opening of each strainer.

3.2 ADJUSTMENT AND CLEANING

A. Adjust all valves and specialties to operate smoothly and without binding or leaking. Test and prove all vents to open freely for the passage of air. Locate strainers as necessary to allow easy cleaning.

END OF SECTION

PIPING SPECIALTIES

SECTION 15140

PIPE SUPPORTS AND ANCHORS

PART 1 - GENERAL

- 1.1 DESCRIPTION OF WORK:
 - A. Provide piping supports, hanger, guides and anchors as indicated on the Drawings and as specified.

1.2 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Shop Drawings: Indicate system layout with location and detail of pipe hangers installations.
- C. Product Data: Provide manufacturers catalog data including load capacity. Provide piping and equipment supports, hangers and anchors as indicated on the drawings and as specified or as required to meet the intent indicated on the drawings.
- 1.3 OPERATION AND MAINTENANCE DATA:
 - A. Submit operation and maintenance data under provisions of General Conditions and Division 1 as applicable.
 - B. Include installation instruction, assembly views, lubrication instructions, and replacement parts list.
 - C. Submit for pipe supports, hangers and anchors.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. All hangers, supports and anchors for pressure piping shall be in accordance with the ANSI B-31 and be electrogalvanized finished for protection from moisture and air. No plain "black" material or other materials will be allowed.
- B. Horizontal Piping Hangers
 - 1. Provide one of the following types of hangers for horizontal piping manufactured by Grinnell, Superstrut, Unistrut, B-Line, Inc., Tolco.
 - 2. Copper tubing support hangers for uninsulated pipe. Provide Superstrut C716 Isolator, Grinnell, or equal.
- C. Beam clamps shall be malleable iron, Superstrut M775L, Unistrut M29, or equal, clamp with lock nut for 3/8 inch hanger rods, steel beam clamp, Superstrut U564, Unistrut P1648-P1653 Series, for hanger rod up to 3/4 inches. Design load shall not exceed printed loads of U564 with design data safety factor 5.
- D. Inserts: Provide continuous insert channel, with closure strip, Superstrut C302, Unistrut P3249 to 3270 Series, for grid insert system. For single inserts, Superstrut 452, Unistrut M26. Do not exceed hanger rod design load table as published in this section.

- E. Saddles and Shields
 - 1. Saddles
 - a. Hot Water Piping Saddles: Provide saddles Grinnell 160, Superstrut, on all hot water systems where water temperature exceeds 110 degrees F.
 - 2. Shields
 - a. Provide shields to protect insulation in all areas where saddles are not specified to protect insulation at areas of contact with hangers and supports.
 - b. Provide Superstrut C790, B-Line B3154.
- F. Anchors and Guides: Provide anchors and guides as necessary. Guides shall be Grinnell Fig. 256 with Fig. 1007, Keflex Series P.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide hangers to support the required loads. Support to permit movement due to expansion and contraction. Where Drawings indicate details of supports and anchors, conform to details shown. Where details are not shown, conform to requirements of this section.
- B. Insulation Protection Shields: Hangers and supports shall fit outside of all pipe insulation and insulation inserts. Provide galvanized steel protection shields centrally located at all hangers and supports of insulated piping. Shields shall be 14-gauge, 12-inch-long and shall cover one-half of the insulation or inserts to prevent any direct contact with hangers or supports. Insert sections shall be provided as specified.
- C. Hang pipe from primary building structure. Piping shall not be hung from ceiling deck and other piping. All rigid hangers shall provide a means for vertical adjustment after erection.
- D. Where noninsulated pipes, in which vibration may occur, pass through walls, floors, or partitions, encase pipe in acoustical wall sleeves.

3.2 HORIZONTAL PIPING SUPPORT SCHEDULE

- A. Maximum spacing between single supports for copper tubing shall be in accordance with table, 15140-A attached at the end of this section.
- B. The spacing specified herein is included to limit deflection in the pipe to an acceptable minimum. Shorten intervals as necessary so the support manufacturer's maximum recommended safe load values in accordance with ANSI B 31.1 are not exceeded.

3.3 VERTICAL PIPING SUPPORT

- A. Support all vertical piping independent of horizontal piping.
- B. Where pipe sleeves extend above floor, place pipe clamps at ceiling below, support clamp-end extension from inserts.
- C. Where pipe sleeves extend above floor, place pipe clamps at ceiling below, support clamp-end extension from inserts.
- D. Support all vertical pipes that penetrate the roof deck with unistrut attached to framing member, not deck. The pipe will be supported at the roof deck just below the deck and also minimum 24" below deck with unistrut to prevent rotational movement.

3.4 SADDLES

A. After installation, saddles to be filled with Pipe insulation specified in Section 15250.

TABLE NO. 15140-A

PIPING SUPPORT SCHEDULE						
Type of Pipe	pe of Pipe <u>1" dia</u>		<u>1 ¼" to 1 ½"</u>	<u>1 ¼" to 2 ½"</u>	<u>3" dia. and</u>	
			<u>dia.</u>	<u>dia.</u>	<u>over</u>	
Steel Pipe	6'-0"		10'-0"	12'-0"	12'-0"	
Copper Tubing	5'-0"		6'-0"	10'-0"	10'-0"	
<u>Type of Pipe</u>	<u>1" dia</u>	<u>or under</u>	<u>1 ¼" to 1 ½"</u>	<u>1 ¼" to 2 ½"</u>	<u>3" dia. and</u>	
			<u>dia.</u>	<u>dia.</u>	over	
Gas Piping	6'-0"		10'-0"	12'-0"		
Cast Iron:	Support at every joint, each side of no-hub coupling, and					
	10 0					
All Thread Rod Pipe		Rod Size		Maximum Design Load		
2" and smaller		3/8"		610 #		
2 and smaller 2-1/2" to 5"		1/2"		1130 #		
6" to 8"		5/8"		1810 #		

END OF SECTION

PIPE SUPPORTS AND ANCHORS

SECTION 15170

MOTOR AND VARIABLE FREQUENCY DRIVE

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - 1. Three phase electric motors.
 - 2. Single phase electric motors.
 - 3. Variable frequency drive.

1.2 REFERENCES:

- A. AFBMA 9 Loaded Ratings and Fatigue Life for Ball Bearings.
- B. AFBMA 11 Load Ratings and Fatigue Life for Roller Bearings.
- C. ANSI/IEEE 112 Test Procedure for Polyphase Induction Motors and Generators.
- D. ANSI/NEMA MG I Motors and Generators.
- E. ANSI/NFPA 70 National Electrical Code.
- F. IEEE Std. 519-1981 Guide for Harmonic Controls and Reactive Compensation of Static Power Converters.
- G. ANSI/UL Std. 508 Testing by Independent Laboratories.

1.3 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Submit test results verifying nominal efficiency and power factor for three phase motors larger than 20 horsepower.
- C. Submit manufacturers' installation instructions under provisions of Division 1.

1.4 OPERATING AND MAINTENANCE DATA:

- A. Submit operation and maintenance data under provisions of Division 1.
- B. Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.5 QUALIFICATIONS:

- A. Manufacturer: Company specializing in manufacture of electric motors and adjustable frequency controllers for HVAC use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
- 1.6 REGULATORY REQUIREMENTS:
 - A. Conform to applicable electric code.

- B. Conform to local energy code.
- 1.7 DELIVERY, STORAGE AND HANDLING:
 - A. Deliver products to site under provisions of Division 1.
 - B. Store and protect products under provisions of Division 1.
 - C. Protect motors and controllers stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.
- 1.8 WARRANTY:
 - A. Provide one (1) year manufacturer's on-site labor and material warranty for motors and adjustable frequency drives under provisions of Division 1.
 - B. Warranty: Include coverage for motors larger than ³/₄ horsepower.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS:
 - A. Motors: General Electric, Westinghouse, Baldor, Toshiba/Houston, U.S.
 - B. Variable Frequency Drive: Magnetek, Danfoss and ABB.
- 2.2 GENERAL CONSTRUCTION AND REQUIREMENTS:
 - A. Motors: Design for continuous operation in 40 degrees C environment and for temp accordance with ANSI/NEMA MG 1 limits for insulation class, Service Factor, and motor enclosure type.
 - B. Motors installed in outdoor locations shall be totally enclosed, fan cooled and continuous duty rating at 55 degree C and 1.00 service factor.
 - C. Controllers Design for operation with the actual motor and driven pumps or fans.
 - D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor.
 - E. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.
- 2.3 THREE PHASE POWER SQUIRREL CAGE MOTORS
 - A. Starting Torque: Between one and one and one-half times full load torque.
 - B. Starting current: Six times full load current.
 - C. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B characteristics.
 - D. Design, Construction, Testing and Performance: Conform to ANSI/NEMA MG 1 for Design B

MOTOR AND VARIABLE FREQUENCY DRIVE

motors.

- E. Insulation System: NEMA Class B or better.
- F. Testing Procedure: In accordance with ANSI/IEEE 112, Test Method B. Load test motors to determine from the electrical or mechanical defects and compliance with performance data.
- G. Motor Frames: NEMA standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- H. Bearings: Grease lubricated anti- friction ball bearings with housings equipped with plugged provisions for re-lubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- I. Sound Power Levels: To NASI/NEMA MG 1.
- J. Nominal Efficiency: Meet or exceed values in schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112.
- K. Nominal Power Factor: Meet or exceed values in schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112.
- L. Motors shall deliver full nameplate horsepower without derating due to thermal considerations when on variable frequency power.

2.4 VARIABLE FREQUENCY DRIVE (VFD)

- A. Variable Frequency Drive Systems shall be compatible with any standard NEMA B design
 3-phase induction motor. Variable Frequency Drive Systems shall be sized to insure the motor full load amps do not exceed the controller continuous RMS amps.
- B. The adjustable frequency drive shall convert three-phase, 60 Hz utility power to adjustable voltage and frequency, three phase, AC power for stepless motor speed motor Control from 10% to 110% of the motors 60 Hz speed. Input voltage shall be as specified on the drawing schedules. The input section of the drive shall include line reactors or isolation transformers as required to meet IEEE 519 for distortion levels of 5% or less. The variable frequency drives shall not interfere with sensitive electronic equipment that is fed from the same power distribution system.
- C. The Output wave form shall be either six step or sine coded pulse width modulated. To eliminate acoustical noise, PWM drives shall have a minimum of 2500 pulses per sine. The VFD's input power factor shall be.95 or better at all operating speeds. Efficiency shall be 96% minimum from 0-100% load. To eliminate RFI and EMI, the drive shall comply with FCC rules and regulations, part 15, subpart J.
- D. Solid State Ground Fault Protection shall be standard. Those manufacturers that cannot provide this as a standard feature must supply an external protector. Adaptive electronic motor overload protection shall be provided which shall protect both the moto frequencies. Electronic thermal overload circuits which properly protect the motor only at full speed shall not be acceptable. The VFD shall sense the load and speed and shall recalibrate the thermal trip curve to insure low speed motor protection. The initial trip point shall be adjustable from at least 40-100% of the VFD amperage rating.
- E. Isolated control inputs shall be provided. The motor speed shall be directly proportional to 0-10 volt, 4-20 mA, and variable resistance signals.

MOTOR AND VARIABLE FREQUENCY DRIVE
- F. Drive operation options shall be switch selectable and shall include at a minimum the following functions:
 - 1. Automatic reduction in voltage with a reduction of load. This energy saving feature shall not sacrifice acceleration torque.
 - 2. The VFD shall provide the following operational features:
 - 3. Speed search transfer. The VFD shall be able to start from bypass or fault trip into a spinning load without stopping the motor or creating a fault condition. The VFD shall match the motor's speed and then drive the motor to its proper speed.
 - a. Adjustable current limit threshold.
 - b. Multiple restart upon fault trip.
 - c. Minimum 10:1 speed ratio.
 - d. Individually adjustable acceleration and deceleration patterns, adjustable from 0. 1 -1800 seconds.
- G. The VFD shall be suitable for installation and use under the following environmental conditions: 20 to 114 deg.F, 0-90% RH, non condensing.
- H. Fault Indication and Operation:
 - The following fault conditions shall cause the VFD to shut-off (trip) and shall be annunciated by LED indicators on the control board. <u>FU:</u> Fuse Blown, <u>OC</u>: Instantaneous Overcurrent, <u>OV</u>: Overvoltage, <u>UV</u>: Undervoltage, <u>OH</u>: Overheat <u>EB</u>: External Failure, <u>CPF</u>: Control Function Error, <u>CFP-SEL</u>: Control Function Selection Error, <u>OL</u>: Overload
 - 2. The VFD shall attempt to restart a minimum of 5 times after tripping on a fault. A dry contact on the VFD shall close after the fifth unsuccessful restart attempt.
- I. The VFD shall be equipped with a digital operator interface which shall allow the following functions:
 - 1. Digital frequency indication on an LCD display.
 - 2. Digital fault indication on the LCD display. Digital Fault reset. Storage and operator initiated recall of the fault conditions in this sequence of occurrence.
 - 3. Auto/Manual operation switch.
 - 4. Digital speed control in 0. 1 Hz increments.
 - 5. Tracking of fault/failure history.
 - 6. Display of frequency or RPM.
 - 7. Self diagnostics.
- J. Manual bypass shall provide all the circuitry necessary to safely transfer the motor from the VFD to the power line, or from the line to the controller while the motor is at zero speed. Two motor contractors, electrically interlocked, shall be utilized. One contractor is to be between the controller output and the motor, controlled by the controller regulator; and the other one is to be between the bypass power line and the motor, providing across-the-line starting. Motor protection is to be provided in both the "controller' mode and the "bypass" mode by a motor overload relay. The 115VA-C relay control logic, allowing common start-stop commands in the controller" mode and the "bypass" mode shall also be included within this enclosure. The bypass shall include a door interlocked, main power input disconnect circuit breaker providing positive shutdown of all input power to both the bypass circuit breaker installed in the VFD. This disconnect shall provide the ability to safely troubleshoot and test the controller, both energized, while operating in the "bypass" mode and shall mount within the controller enclosure, in a conditioned space.
- K. The VFD manufacturer shall maintain and staff nationwide service centers. Service engineers shall be factory trained, local and certified by the manufacturer and shall provide start up service including physical inspection of drive and connected wiring and final adjustments to meet specified performance requirements.

MOTOR AND VARIABLE FREQUENCY DRIVE

PART 3 - EXECUTION

- 3.1 APPLICATION
 - A. Single Phase Motors need not conform to these specifications.
 - B. Motors shall be open drip-proof type, except where specifically noted otherwise.
 - C. Motors shall be energy premium efficient type.
 - D. Motors located in exterior locations shall be totally enclosed type.
 - E. Adjustable frequency controllers shall be as scheduled on the drawings.
- 3.2 PERFORMANCE SCHEDULE: THREE PHASE-OPEN, DRIP-PROOF
 - A. Motors shall be tested to IEEE-1 12, Method B. Minimum efficiencies and power factors are:

		NEMA	Percent
<u>HP (Syn)</u>	<u>RPM</u>	<u>Efficiency</u>	Power Factor
1	1800	82.5	63.3
1-1/2	1800	84.0	83.8
2	1800	84.0	84.4
3	1800	86.5	88.7
5	1800	87.5	88.0
7-1/2	1800	88.5	84.0
10	1800	89.5	85.2
15	1800	91.0	82.9
20	1800	91.0	87.2
25	1800	91.7	80.3
30	1800	92.4	81.8

END OF SECTION

MECHANICAL IDENTIFICATION

PART 1 - GENERAL

- 1.1 SECTION INCLUDES:
 - A. Nameplates.
 - B. Tags.
 - C. Pipe Markers.

1.2 REFERENCES:

A. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Samples: Submit labels and tags for each system.

1.4 PROJECT RECORD DOCUMENTS:

A. Record actual locations of tagged valves.

PART 2 - PRODUCTS

2.1 NAMEPLATES:

- A. Description: Manufacturer's standard or laminated three-layer plastic with engraved black letters on light contrasting background color; one inch high with 3/4 inch lettering through light layer.
- 2.2 TAGS:
 - A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter or square with smooth edges.
 - B. Chart: Typewritten letter size list in anodized aluminum frame.

2.3 COLOR CODE:

A. Green - Plumbing piping, systems and equipment including valves.

2.4 PIPE MARKERS:

- A. Color: Conform to ANSI A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.5 CEILING TACKS:

A. Description: Steel with 3/4 inch diameter color coded head.

2.6 MANUFACTURERS:

A. W.H. Brady, Seton Name Plate.

PART 3 - EXECUTION

- 3.1 PREPARATION:
 - A. Degrease and clean surfaces to receive adhesive for identification materials.
- 3.2 INSTALLATION:
 - A. Install plastic nameplates with corrosive-resistant mechanical fasteners, screws or rivets only. Consult with Architect when such method conflicts with the manufacturer's warranty and/or requirements.
 - B. Install tags with corrosion resistant chain.
 - C. Install plastic pipe markers in accordance with manufacturer's instructions.
 - D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
 - E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
 - F. Identify large devices with plastic nameplates or stencil painting. Small devices, may be identified with tags.
 - G. Identify control panels and major control components outside panels with plastic nameplates.
 - H. Identify valves in main and branch piping with tags.
 - I. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape and pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on

straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

- J. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape and pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- K. Identify ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- L. Provide red ceiling tacks ³/₄" Diameter to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.
- M. Room temperature sensors shall have engraved nameplates on wall adjacent to temperature sensor that identify the room number, zone number and the HVAC unit number that serves that room.

END OF SECTION

VIBRATION ISOLATION AND SEISMIC CONTROL

PART 1 - GENERAL

1.1 WORK DESCRIPTION:

A. Provide all vibration isolators for mechanical equipment to prevent the transmission of vibration and mechanically transmitted sound to the building structure as indicated on the Drawings and as specified. Include adjustments of each mounting system. Provide specific mounting arrangements for each item of electrical equipment as described herein, and as indicated by details on the Drawings.

1.2 RELATED WORK:

- A. Division 3 Concrete.
- B. Section 15140 Pipe Supports and Anchors.

1.1 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Submit the following Shop Drawings, Product Data and Calculations:
 - 1. Manufacturer's model number of each isolator, the machine or pipeline to which it is to be applied, and the number of isolators to be furnished for each machine or pipeline.
 - 2. For Steel Spring Mounts or Hangers: Free height, deflected height, solid height, isolator loading, and diameter of spring coil.
 - 3. For Neoprene Isolators: Free height, deflected height, and isolator loading.
 - 4. Dimensional and weight data for steel and rail bases, and details of isolator attachment.
 - 5. For Seismic Slack Cables: Indicate method to achieve vertical restraint.
 - 6. Provide seismic calculations to meet applicable codes for all mechanical equipment (isolated or non-isolated), piping and ductwork. Calculations shall be signed by an engineer registered in the State of Nevada with experience in the design of restraints for flexibly mounted equipment. Seismic restraint design and anchorage design are part of this certification requirement.

1.2 QUALITY ASSURANCE:

A. Provide seismic restraints on equipment as required by code as detailed on the Drawings. Include motors, AC's, control panels and exhaust fans. Installation of lateral and vertical restraining devices for ductwork and piping shall be in accordance with SMACNA "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems".

PART 2 - PRODUCTS

- 2.1 MATERIALS:
 - A. General:
 - 1. Provide vibration isolators in accordance with the weight distribution to produce uniform deflection. Furnish deflections indicated.
 - 2. Where indicated, schedules, or specified, provide specific vibration isolation equipment,

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VIBRATION ISOLATION AND SEISMIC CONTROL

manufactured by Mason Industries, Inc., M.W. Sausse Co. (Vibrex). Where specific type of vibration isolation equipment is not shown or specified, furnish isolators recommended by the isolation manufacturer compatible with equipment arrangements shown. Provide products of single manufacturer for all vibration isolation equipment.

- B. Isolators:
 - 1. General: Provide spring diameters no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid, equal to 50 percent of the rated deflection.
 - 2. Isolator Type 1, Neoprene Mounting: Double deflection neoprene mounting sized for a static deflection under load in the range of 0.25-0.5 inch. All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Provide bolt holes for those areas where bolting is required. Isolators shall be Mason Type "ND", Vibrex Type "RD".
 - 3. Isolator Type 2, Freestanding Springs: Provide freestanding and laterally stable spring isolators without any housing and complete with 1/4-inch neoprene acoustical friction pads between the baseplate and the support. Provide all mountings with leveling bolts, rigidly bolted to the equipment. Isolators shall be Mason Type "SLF", Vibrex Type "RMS".
 - 4. Isolator Type 3: Housed spring mounting with limit stop. Springs in housings shall be as specified for Isolator Type 2. Provide housing with vertical resilient limit stops to prevent spring extension when weight is removed, as when equipment is drained. The housing shall serve as blocking during erection and the installed and operating to be the same. A minimum clearance of 1/4-inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Isolators used outside shall be hot dipped galvanized and springs neoprene coated. Isolators shall be Mason Type "SLR", Vibrex Type "RMLS".
 - 5. Isolator Type 4, Vibration Hanger: Vibration hanger to contain a steel spring and 0.3inch deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Provide spring diameters and hanger box lower hold sizes large enough to permit the hanger rod to swing through a 30 degree arc before contracting the hold and short circuiting the spring. Isolators shall be Mason Type "30N", Vibrex Type "HXA".
 - 6. Isolator Type 5, Vibration Hanger: Vibration hanger to contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. The cup shall contain a steel washer designed to distribute the load on the neoprene and prevent its extrusion. Provide spring diameters and hanger box lower hole sizes large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Provide hangers with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps. Hangers shall be Mason Type "@30", Vibrex Type "RMXA".
 - 7. Isolator Type 6, Vibration Hanger: Hanger to be a double deflection neoprene-in-shear, sized for a static deflection under loads of 0.25-0.35-inch. Isolators shall be Mason Type "HD" or "WHD", Vibrex Type "HSS".
 - 8. Isolator Type 7, Vibration Pad: Pad shall be neoprene at least 3/4" thick. Pad shall be Mason Type Super W, Vibrex.
- C. Isolation of Piping Systems:
 - 1. Suspend all metal piping which connect to resiliently mounted equipment with resilient hangers or supported by floor mounted isolators within mechanical rooms. The first three supports from the connected machine to have the same static deflection as indicated for the machine. The remaining supports to have static deflection at least equal to one-half of the static deflection indicated for the machine.
 - 2. Where static deflection in excess of 0.35 inches is required, floor isolators shall be Type 3 and isolation hangers shall be Type 4. Where deflection of less than 0.35 inches is

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required, floor isolators shall be Type 1 and isolation hangers to be Type 5.

- D. Flexible Connections:
 - 1. Use flexible neoprene connectors to prevent all piping to all isolated equipment, except equipment for this flexible connectors are not permitted by codes listed.
 - 2. Connectors to be manufactured of multiple ply's of nylon tire cord fabric and neoprene, both molded and cured in hydraulic presses. Use no steel wire or rings as pressure reinforcement. Connectors up to, and including, 2-inch diameter may have threaded ends. Connectors 2-1/2 inches and larger shall be manufactured with floating steel flanges. Rate connections to a minimum of 150 psi at 220 degrees F. Flanged equipment shall be directly connected to neoprene elbows in the size range 1-1/2 through 6 inches or any larger available size if the piping make a 90 degree turn at the equipment. Make all straight through connections with either flanged or screwed connectors pre-extended as recommended by the manufacturer to prevent additional elongation under pressure.
 - 3. Drain connections from isolated equipment to floor drains shall have least 1-inch air gap above from drain.
 - 4. Acoustical Sleeves: Where piping passes through equipment walls, floors or ceilings, provide a split seal consisting of two bolted pipe halves with 3/4-inch or thicker neoprene sponge bonded to the inner faces. Tighten the seal around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete shall be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Project the seals a minimum of 1-inch past either face of the wall. Where temperatures exceed 240 degrees F., 10 lb. density fiberglass shall be used in lieu of the sponge.
- E. Isolation of Fractional Horsepower Equipment: Isolate all fractional horsepower fans, pumps, and equipment which are mounted on or suspended from floors that are not on-grade with neoprene-in-shear isolators as specified except where such isolators are furnished as an integral part of the machine.
- F. Electrical Connections to Resiliently Mounted Equipment: Make electrical connections to equipment which is supported or suspended by vibration isolators with long lengths of flexible steel conduit or flexible armored cable. Locate these flexible connections so as to prevent rigid connections between the resiliently mounted equipment and the building structure.
- G. Seismic Restraints:
 - 1. Floor mounted equipment, piping and ductwork.
 - a. Type S. Similar to Type 3 as specified in Paragraph 2.1 C., Isolators, designed for earthquake loads. Restraints shall be Mason Type SSLR or SSLFH, Vibrex Type "RMU-EQ-SH" or "RMLS-EQ".
 - b. Type SL. All directional seismic restraints shall consist of interlocking steel members restrained by a one-piece molded bushing or bridge-bearing neoprene. Bushing shall be replaceable and shall have a minimum thickness of 1/4-inch. Incorporate a minimum air gap of 1/8-inch in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Provide removable snubber ends to allow inspection of internal clearances. Neoprene bushing shall be rotated to ensure no short circuits exist. Restraints shall be Mason, Type Z1225, Vibrex Type "3200".
 - 2. Suspended equipment, piping and ductwork: Type SC, Seismic Slack Cables: Arrange cables to achieve the specified all-directional restraints, and sized to resist seismic loads. Install cables with sufficient slack to avoid short circuiting the vibration isolators. Restraints shall be Mason, Vibrex, Type Seismic Slack Cables.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install resilient hangers as near as possible to the supporting overhead structure. Locate the machine suspension points in a rigid and heavy portion of the building structure. Suspension of machines from lightweight floor slabs is not allowed.
- B. Attach suspension rods to rigid members of the machine structure. When such attachment points do not exist, furnish a heavy steel framework to support the machine with suspension rods attached to this framework.
- 3.2 FIELD QUALITY CONTROL
 - A. Ensure that all vibration isolators are installed in accordance with manufacturer's printed recommendations.
 - B. Replace, as approved by the Engineer, isolators which do not produce the required deflection, are inaccurately loaded above or below their correct operating height, or which do not produce the required isolation.

END OF SECTION

MECHANICAL INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide materials and accessories for the installation of mechanical insulation as indicated on the Drawings and as specified.

1.2 QUALITY ASSURANCE

- A. All insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation) fire and smoke hazard ratings as tested by procedure ASTM E84, NFPA 255, and UL 723 not exceeding: Flamespread 25; Smoke Developed 50.
- B. Accessories such as adhesives, mastics, cements, tapes and fiberglass cloth for fittings shall have the same component rating as listed above.
- C. Insulation shall comply with Federal Specifications (FS) HH-I-552, HH-I-558, ASTM C547 and MIL-I-22344B.
- D. All insulation shall have fire and smoke ratings as tested by Procedure ASTM E84, NFPA 225, and UL 723 and as required by UMC and shall not exceed a flamespread of 25 and a smoke development of 50.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- A. Submit the following items:
- B. All insulation materials.
- C. All jacket and facing materials.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of General Conditions and Division 1 as applicable.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Tape: Wherever tape is used for sealing purposes, provide a type as recommended by the nonconductive covering manufacturer. Where recommendation is lacking, seal the tape used

MECHANICAL INSULATION

with Minnesota Mining and Manufacturing Company adhesive EC-1329.

- B. Insulating Cement: Insulating cement shall be Owens-Corning 110 mineral wool, all-purpose cement. Where insulating cement is applied to pipe fittings in concealed locations, provide a "one-coat" cement.
- C. Pipe Insulation: Pipe insulation shall be multiservice-type suitable for all lines operating from 20° to 500° F. Insulation shall be one-piece consisting of glass fibers bonded with phenolic resin and molded into a hollow cylinder covered with a factory applied vapor barrier jacket.
 - 1. Thermal conductivity (Btu/hour square foot degrees F./inch) shall not exceed:
 - a. At 75° F. mean temperature 0.22
 - b. At 100° F. mean temperature 0.23
 - c. At 200° F. mean temperature 0.25
 - 2. Vapor barrier jacket shall be heavy duty all service jacket (ASJ) consisting of laminated aluminum foil, glass reinforcing and white building paper. Perm rating shall be 0.01. Vapor barrier to form a vapor tight system.
- D. Exterior Pipe Insulation Jackets: Provide aluminum jacket 0.016 inches thick, The Aluminum Association Type 3003 or 5005 alloys, with 3/16-inch longitudinal or circumferential corrugations. Provide jacket with factory-applied vapor barrier on the inside and apply using aluminum straps over transverse joints. Match corrugations from one section of cover to the other. On vertical runs the upper cover to lap over the lower cover and the seams shall be toward walls, horizontal seams shall be on the bottom of the run. Factory fabricate fitting and valve jackets of the same material as the pipe jacket. Seal all jacket joints and seams watertight.
- E. Premolded Pipe Fitting Covers For Interior Use: Covers shall be factory-premolded one-piece polyvinyl chloride (PVC). Covers shall have a snow-white finish and shall withstand surface operating temperatures from 35 to 150 degrees F. continuous usage. All covers shall conform to Federal Specification L-P-535, Composition A, Type II, and shall be Ceel-Co. Series 100, Certainteed "snap-form," Zeston.
- F. Exterior Duct Insulation Coating: Provide elastomeric polymer-based vapor barrier and weatherproof coating. The vapor barrier coating shall be applied in a uniform pinhole-free coat to a minimum dry film thickness of 25 mils. The insulation shall be free of moisture, excessive rough texture, deteriorated surface, dirt, and debris. The coating shall be applied on the same day that the insulation is applied whenever possible. The coating shall be UL classified and meet NFPA standard 90A and National Fire Code 220(b). Coating shall be Childers Encacel V, Marathon Industries Type 570.
- G. Glass Fiber Semi-Rigid Board Insulation
 - Glass fiber semi-rigid board insulation shall be 3 pounds per cubic foot semi-rigid board material of long glass fiber with resin binder. Thermal conductivity shall not exceed 0.24 Btu/hr square foot degrees F./IN at 75 degrees F. mean temperature. Insulation shall be applied to the inside of housing with 100 percent coverage of adhesive. Childers Products CP-88, Benjamin Foster 85-15, and mechanical fasteners recommended by the insulation manufacturer, spaced 12 inches on centers.
 - 2. Insulation shall be coated on one side with a neoprene compound to securely bond fibers against erosion in air stream.
- H. Flexible Duct Insulation: Flexible duct insulation shall be adhered to the duct with Benjamin Foster 85-15, Childers Products CP-88, adhesive applied in 6-inch strips around the duct on 12inch centers. Tying cord or twine shall be used to secure the insulation. Vapor barrier at butted joints shall be sealed with Minnesota Mining and Manufacturing Company, Childers Products, vapor barrier tape. Where insulation is furnished with vapor barrier flange, flanged joint shall be sealed with vapor barrier mastic.

- I. Equipment Exteriors Requiring Vapor Barrier
 - 1. Glass fiber semi-rigid board insulation used where required in 15250-D. Use 3 pounds per cubic foot material of long fiberglass with resin binder. Thermal conductivity shall not exceed 4 Btu/hr square foot degrees F./IN at 100 degrees F. mean temperature. Impale grooved and shaped boards on pins spaced 12 inches on center and securely fasten with self-locking metal caps swabbed with vapor barrier mastic, Owens-Corning, Childers Products.
 - 2. All insulation edges and butt joints shall be sealed with Owens-Corning, Childers Products, pressure sealing tape. Insulation shall be faced with a vapor barrier jacket consisting of laminate of 0.001-inch aluminum foil and pre-sized glass cloth.
- J. Premolded Pipe Fitting Covers: Interior used covers shall be factory-premolded one-piece polyvinyl chloride (PVC-FR). Covers shall have a snow-white finish and shall withstand surface operating temperatures from 35 to 150 degrees F. continuous usage. All covers shall conform to Federal Specification L-P-535, Composition A, Type II, and shall be Ceel-Co. Series 100, Certainteed "snap-form," Zeston.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The insulation and materials shall be applied by mechanics skilled at such Work together with the required number of apprentices. The appearance of the finished Work shall be of equal importance with its mechanical correctness and efficiency. Insulation for heating surfaces and piping shall not be applied until such times as those surfaces have been heated to dry out the insulation. Insulation shall not be applied until the system is tested as required.
- B. Wherever vapor barriers are specified, vapor seal all portions of the covering at joints and fittings.
- C. Insulation shall be continuous through all walls, floors, and ceilings unless otherwise specified, or shown.
- D. Where insulation is to be painted, prepare all surfaces to receive paint.
- E. Insulate unions, flanges, and valve bodies but not operating handwheels or levers.
- F. Application of all materials shall be in accordance with the manufacturer's printed instructions.
- G. Handle the insulation in a manner that will not adversely affect its structural or insulating properties.
- H. Provide support for the insulation on vertical lines to prevent the insulation from slipping downward.
- I. Do not place insulation over vent and drain inlets and outlets.
- J. Self sealing laps to have an additional field applied coat of adhesive applied to the opposite mating surface. Stapled insulation is not acceptable. The insulation longitudinal joints shall be in alignment away from view.
- K. Seal all exposed insulation and joint openings in jackets.
- L. Provide insert, not less than 12" long, of same thickness and contour as adjoining insulation, between support shield and piping, but under the finish jacket, on piping 2" diameter or larger, to

prevent insulation from sagging at support points. Insert shall be cork or other heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.

- M. Where pipe hanger rods penetrate vapor barrier, vapor barrier to be carried up and sealed around rod for a distance of 12 inches away from the outside of the pipe insulation.
- N. Fittings and Valves
 - 1. Hot Pipelines (above 60 degrees F.)
 - a. Flanges, couplings, valves, anchors, and fittings shall be insulated with factory premolded, prefabricated or field fabricated sections of insulation of the same material and thickness as the adjoining pipe insulation.
 - b. When segments of insulation are used, provide elbows with not less than three segments. When nesting size sections of insulation are used, all voids shall be filled with insulating cement or mineral fiber. Secure sections of insulation in place with wire or by joining the sections with adhesive.
 - c. Apply adhesive over the insulation in two coats with glass cloth or tape embedded between coats. Cloth or tape shall overlap itself 1 inch and adjoining insulation jacket 2 inches.
 - d. Inserts to be installed in accordance with the fitting manufacturer's printed. Cover insulated flanges, couplings, valves, anchors, and fittings with preformed or field-fabricated sections of aluminum jacket secured with bands in lieu of finishes specified above.
 - e. When pipe insulation with factory-applied aluminum jacket is provided, flanges, valves and fittings may be insulated with factory-or-field-fabricated sections of the same material and thickness as adjoining pipe insulation and jacket. Secure sections with bands. Unless otherwise shown, unions will not be insulated and pipe insulation and jacket shall terminate neatly at the ends of unions.
 - f. Finish all termination points with a brush coat of adhesive.
 - Cold Pipelines (-30 to +60 degrees F.)
 - a. Flanges, couplings, unions, valves, anchors and fittings unless otherwise shown insulate with factory premolded, prefabricated or field fabricated sections of insulation of the same material and thickness as the adjoining pipe insulation.
 - b. When nesting size sections of insulation are used, fill all voids with insulating cement or mineral fiber.
 - c. Secure sections of insulation in place with wire or by joining the sections with adhesive.
 - d. Apply vapor barrier coating over the insulation in two coats with glass tape or cloth embedded between coats. Overlap cloth or tape over itself 1 inch and adjoining insulation jacket 2 inches. Apply the coating to a total dry film thickness of not less than 1/16-inch. Insulate all flanges, couplings, unions, valves, anchors, and fittings with preformed or field-fabricated sections of aluminum jacket applied over the vapor barrier and secured bands. Where unions are shown to be not insulated, terminate the pipe insulation and jacket neatly at the ends of the unions. Seal ends of pipe insulation to the pipe with a brush coat of vapor barrier coating at termination points, valves, flanges, and fittings.

O. Insulation:

2.

- 1. Pipe insulation shall be in accordance with Table 15250-A attached to the end of this Section.
- 2. Valves and Fitting Jackets
 - a. Valves and fitting jackets shall be in accordance with Table 15250-B attached to the end of this Section.

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- b. Cover strainers with an insulated base with a removable cover to permit cleaning of strainer screen when it is removed. Construct base of rigid insulation and vapor barrier equal to that specified for pipe.
- 3. Duct Insulation: Duct insulation to be in accordance with Table 15250-C attached at the end of this Section. Flexible ductwork shall be insulated similar to rigid ductwork.
- 4. Equipment Insulation: Equipment insulation shall be in accordance with Table 15250-D attached at the end of this Section.
- 5. All damaged insulation and damaged insulation jackets shall be removed and replaced with new insulation or jacket lengths to the approval of the Engineer.

TABLE 15250-A								
PIPE INSULATION SCHEDULE								
INSULATION THICKNESS FOR NOMINAL PIPE SIZES								
1 AND 1 1/4" 2 1/2" 6								
	TEMP.	LESS	TO 2	TO 4	AND UP			
SYSTEM	RANGE	<u>IN.</u>	<u>IN.</u>	<u>IN.</u>	<u>IN.</u>	JACKET		
	•							
Hot/Tempered Water								
Domestic								
Hot/Tempered Water	90-200	10	10			All Service		
Return	00 200	1.0	1.0					
Domestic								
-								
Cold Water,	Any	1.0	1.0	1.5		All Service		
Domestic, Non-								
Conditioned Areas								
					1			
Condensate	Any	0.5	0.5	0.5		All Service		
Drain								
Chilled Water	A m(1.0	1.0	1 5	1.5			
Service	Any	1.0	1.0	1.5	1.5	All Service		
Oervice								
Condenser Water	Anv				1.5	All Service		
(Exposed to weather	,,							
only)								
	·	·						
NOTE: All insulation ex	posed to weat	her and to vie	w in mechanic	al rooms and	l air handling	g unit rooms		
shall be provided with a	shall be provided with aluminum covering.							

TABLE 15250-B					
VALVE AND FITTING JACKET SCHEDULE					
SYSTEM	LOCATION	JACKET			
Hot/Tempered Water Domestic	All Concealed	Glass Cloth And Adhesive			
		Or Premolded			
Hot Water Heating	All Concealed	Glass Cloth And			
		Adhesive			
		Or Premolded			
Hot/Tempered Water Domestic	All Exposed	Premolded Cover Interior Only			
Cold Water Domestic	All Exposed	Premolded Cover			
Non-Conditioned Areas		Interior Only			
Air Handling Unit	All	Premolded Cover			
Condensate Drain		Interior Only			

SYSTEM	LOCATION	JACKET
Piping		Glass Cloth And Vapor
Chilled Water and Equipment	All Concealed	Cover
	Barrier And Premolded	
Chilled Water And	All Exposed	Metal Jacket
Equipment		
Equipment	All Exposed	Metal Jacket
All Exterior Piping	All Exposed	Rigid Insulation with Full Metal
	-	Jacket

TABLE 15250-C						
DUCT INSULATION SCHEDULE						
<u>SYSTEM</u> <u>LOCATION</u> <u>INSULATION</u> <u>JACKET</u>						
Supply Air	Concealed/	Glass Fiber	All Service			
Heating & Cooling	Exterior	2 Inch	Flexible			
Supply Air	Exposed	Glass Fiber	Flexible Coating			
Heating & Cooling	in Cooled &	1-1/2 Inch	Per 2.1			
	Heated Space					
Return Air	Concealed In	Glass Fiber	All Service			
	Uncooled Or					
Flexible	Unheated Space	1-1/2 Inch				
Return Air	Concealed Or	None	None			
	Uncooled Or					
	Unheated Space					
Return Air	Exposed In	Glass Fiber	Per 2.1			
	Uncooled Or	Flexible				
	Unheated Space					
Coating As Or Mechanical		1-1/2 Inch				
Insulation	Rooms					
Outside Air	All	Glass Fiber	Flexible Coating			
		2 Inch	Per 2.1			

NOTE: All insulation exposed to weather and exposed to view in mechanical rooms and laboratories shall be provided with elastomeric polymer-based vapor barrier and weatherproof coating.

TABLE 15250-D					
EQUIPMENT INSULATION SCHEDULE					
Cooled Equipment	Insulation	Finish Cover			
Air Conditioning	Glass Fiber-Coated	Glass Cloth With			
Equipment Housings,	Semi-Rigid Board	Vapor Barrier			
Interior	Insulation, 1 Inch				

END OF SECTION

MECHANICAL INSULATION

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PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Work of this Section includes everything necessary and incidental to completing plumbing work, except as herein specifically excluded.

1.2 RELATED SECTIONS

- A. Division 9 Painting.
- B. Section 15140- Pipe Supports and Anchors.
- C. Section 15190 Mechanical Identification.
- D. Section 15240 Vibration Isolation and Seismic Control.
- E. Section 15250 Mechanical Insulation.

1.3 REFERENCES

- A. AGA Z21.22 Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.
- B. ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
- C. ASME B16.3 Malleable Iron Threaded Fittings.
- D. ASTM B32 Solder Metal.
- E. ASTM B88 Seamless Copper Water Tube
- F. CISPI 301 Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- G. American Water Works Association (AWWA) C651-05 Disinfection of water mains.

1.4 SUBMITTALS FOR REVIEW

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- 1.5 QUALITY ASSURANCE
 - A. Valves: Manufacturer's name and pressure rating marked on valve body.
- 1.6 REGULATORY REQUIREMENTS
 - A. Perform Work in accordance with UPC, ANSI/ASME B3.9.

1.7 DELIVERY STORAGE AND PROTECTION

- A. Division 1 Material and Equipment: Transport, handle, store, and protect products.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

- 2.1 PIPING INSTALLATION
 - A. Description:
 - 1. Arranged as shown on the Drawings and as required for complete systems.
 - B. General:
 - 1. Unless otherwise specified herein, all equipment and fixtures shall be installed in accordance with the manufacturer's recommendations.
 - 2. Before submitting his bid for the work under this division the Contractor shall carefully study all Drawings and shall make a careful examination of the premises. He shall determine in advance, the methods of installing and connecting the apparatus, the means to be provided for getting the equipment into place and shall make himself thoroughly familiar with all the requirements of the Contract. After award of the Contract, no subsequent allowances will be made to the Contractor due to the failure to comply with the above requirements or any other conditions affecting the installation and completion of all work.
 - 3. All scaled and figured dimensions are approximate and are given for estimate purposes only. Before proceeding with any work, the Contractor shall carefully check and verify all dimensions, sizes, etc., of all equipment and materials to other parts of the equipment and to the structure.
 - 4. Any minor changes in work, which have not been installed, shall be made by Contractor without additional compensation except changes which increase or decrease the size of the materials specified or indicated on the Drawings. Contractor shall submit an estimate for the cost of, or credit for, such changes he does not consider of a minor nature and shall proceed only upon the written authority of the Owner.
 - 5. Piping shall be run straight and true to line free of traps, sags, and bends. Risers shall be plumb and form right angles on parallel lines with building walls. Keep pipes close to walls, partitions, off-set only where necessary to follow walls or as directed.
 - 6. Locate, groups of pipes parallel to each other with spacing to permit applying full thickness insulation and to permit access for servicing valves.
 - 7. All piping shall be concealed in walls or above ceilings (below roof) unless otherwise noted.
 - 8. Street elbows, bushings, and long screw fittings will not be allowed.
 - 9. All piping shall be isolated from other piping, any part of the building, framing, conduit, etc., with one inch (1") strips of hair, felt, or pipe isolators.
 - 10. Cleanouts, as specified (see plans for size), shall be no-hub and installed into pipe where shown on plans. Cleanouts shall be accessible in all cases and shall be brought to surface on "WYE" branches. All cleanouts shall be provided with removable floor or wall plate as herein specified.

PLUMBING PIPING

- 11. Install stops on all hot and cold water fixture supplies, unless integral stops are specified. Supply trim shall have all metal-to-metal connections.
- 12. Install fuel gas piping in schedule 40 steel pipes unless otherwise noted.

2.2 DOMESTIC HOT AND COLD WATER PIPING SYSTEM

- A. Mains, risers, branches, connections of sizes and arrangement as indicated on Drawings.
- B. Shut-off valves shall be provided in main branches, runs to risers and where indicated on Drawings.
- C. Metal piping below grade shall be wrapped with "Ten Mil" Polyethylene tape and jacket per ANSI/ AWWA C105.
- D. Joints under concrete slabs, if allowed by local codes, shall be brazed.

2.3 SOIL, WASTE AND VENT PIPING SYSTEMS

- A. Sanitary System:
 - 1. Mains, risers, branches and connections of sizes and arrangement as indicated on Drawings.
 - 2. Schedule 40 PVC soil pipe and solvent-cemented drainage fittings below grade shall be in conformance with UPC/IAPMO Standards.
 - 3. Above grade piping and vent line shall be service weight cast iron with no-hub joints with stainless steel shielded no-hub couplings.
 - 4. Vent piping may be schedule 40 galvanized steel in lieu of item "C" above.
 - 5. Cleanouts shall be provided where indicated on Drawings and in the following locations:
 - a. Near bottom of each stack and riser.
 - b. At every 90° change of direction for horizontal line.
 - c. Every one hundred feet (100') horizontal run.
- B. Extend cleanout to accessible surface. Do not place cleanouts in carpeted floors. In such locations, use wall type cleanouts.
- C. Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have a seal trap in connections with a complete venting system so gasses pass freely to atmosphere with no pressure for syphon condition on water seal.
- D. Vent entire waste system to atmosphere. Discharge fourteen (14) inches above roof. Join lines together in fewest practical numbers before projecting above roof. Offset vent line so they will not pierce roof near an edge or valley.
- E. Use torque wrench to obtain proper tension in cinch bands when using hubless cast iron pipe. Butt ends of pipe against centering flange or coupling.
- F. Grade all soil and waste lines at one quarter inch (1/4") fall per foot minimum in direction of flow.

2.4 LABORATORY DRAINAGE (AW AND AV) SYSTEM:

A. Underground/ aboveground Laboratory Piping: Install polypropylene pipe with mechanical joints and/or electrical fusion joints per manufacturer's recommendations. Pipe material shall be UL, NSF, IAPMO listed and meet requirements of UL-94-VO(non-combustible/ flame retardant), Fire Marshall for fire spread/ smoke development rates, when installed above grade. Piping shall match existing approved materials.

2.5 VALVES

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- A. Provide shut-off valves where indicated and specified, and in following locations:
- B. Risers and main branches at points of take-off from their supply or return mains.
- C. Individual equipment units at inlet and outlet, to permit unit removal for repairs without interfering with remainder of system.
- D. Locate valves for easy access and operation; where concealed, access doors shall be provided. Coordinate requirements with Prime Contractor.
- E. Do not locate valves with stems below horizontal.

2.6 CONCEALED PIPING

- A. Where so indicated or specified, conceal piping in building construction. Install such piping in time so as not to cause delay in work of other trades and to allow ample time for tests and approval; DO NOT COVER BEFORE TEST APPROVAL IS OBTAINED.
 - 1. Run up branches passing through floor into partition; offset above floor close to equipment unit; expose only as much as necessary for final connection.
 - 2. Where furred spaces are indicated, keep pipes close to structural members as possible so as to require minimum furring; in case of furred beams, obtain approval of resulting headroom clearance before installing pipes.
- 2.7 PIPES OVER ELECTRICAL EQUIPMENT
 - A. Do not run piping over electrical equipment.

2.8 CHECK FOR INTERFERENCES WITH OTHER TRADES

- A. Before installing piping, check existing condition and architectural, structural, mechanical, electrical, and fire protection drawings as applicable. MAKE ACCURATE LAYOUT OF ALL PIPING, INCLUDING INSTALLED ELEVATIONS. Submit copies of final layout to other trades for checking and coordinating with their work so that grouped pipes, conduit, and ducts will not interfere with each other, or with full swing doors and will leave minimum headroom as indicated. Coordination of the plumbing piping is the responsibility of this section.
- B. Protect Open Pipe Ends: Keep piping free from scale and dirt; protect open ends whenever work is suspended during construction to prevent foreign bodies entering and lodging there; use temporary plugs, or other approved material for protection.

2.9 EXPANSION JOINTS, ANCHORS, GUIDES AND SEISMIC RESTRAINT

- A. General: Provide for taking up expansion in domestic hot water mains and risers by means of bends and offsets or expansion joints where indicated and/or required.
 - 1. Design of Loops, Bends, Offsets: As required, join bends only by welding only for steel pipes not for PVC, copper, or cast iron; submit design details for approval before fabrication.
 - 2. When installing piping with loop or bend expansion, subject it to cold springing, which will take care of about half of total expansion between cold and hot conditions.
 - 3. Branch connections shall have strain; "ON" when cold, "OFF" when hot.
 - 4. Make riser offsets in manner to avoid pocket forming due to expansion.
- B. Anchors: Provide anchors for controlling direction and extent of pipe expansion at locations indicated on various piping layouts. Submit anchor details for approval prior to installation.
- C. Seismic Restraint: All piping and equipment shall be suitably restrained and anchored in both

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horizontal and vertical directions to withstand seismic forces as required for the State of Nevada. See Architectural and Structural drawings for more information.

2.10 PIPE AND FITTING MATERIALS

- A. Service Defined: Classification and names of services as used in "Schedule of Pipe and Fitting Materials" herein, shall have following meaning:
 - 1. Domestic Hot Water: Water between hot water heaters, storage tank, and plumbing fixture.
 - 2. Domestic Tempered Water: Water between mixing valve, and showers or student used plumbing fixture (where applicable and shown in the drawings).
 - 3. Domestic Cold Water: Water between city water meter and plumbing fixtures and mechanical equipment make-up.
- B. Waste: Sewer connection to plumbing fixtures and terminated in street mains or 5FT outside the Building.
- C. Vent: Piping connection from plumbing fixture and terminated through roof to atmosphere.
- D. Condensate: Drains from mechanical HVAC equipment and terminated in floor sinks or fixture tail piece.
- E. Soil/ Waste Pipe: Any pipe which conveys the discharge of water closets, urinals, appliance or appurtenance in connection with plumbing system, or fixtures having similar functions, with or without the discharge from other fixtures, to the building drain or building sewer.
- F. Fuel Pipe: Any pipe which carries combustible fuel gasses
- G. Schedule: Unless otherwise specified, pipe and fitting materials shall conform to following schedule:
 - Interpretation of Schedule: Figure "40" and "80" following pipe materials in this schedule designate pipe wall thickness, conforming to ASA B36.10, applicable to sizes 1" to 10" inclusive. Figure "40" shall mean "standard", "80" shall mean "extra strong" or "extra heavy", in the accepted trade terminology for pipe wall thickness.
 - a. Fittings shall conform to pipe as to black, galvanized or C-P finish.
 - b. Schedule of Pipe and Fitting Materials

Pipe Pressure	Weight	Material for	Type Fittings	Valve Rating	Shut off
Service		<u>Joints</u>	Material	PI, SWP	Valve Type
Domestic					
Cold			<u>Cast</u>		
<u>Water</u>		AWSA5.8	Bronze/		
Below	Copper K	BcuP Silver	Wrought		FI Port
Ground	Hard Drawn	Braze	<u>Copper</u>	<u>600</u>	Ball
Within the Building					
Pipe Pressure	<u>Weight</u>	Material for	Type Fittings	Valve Rating	Shut off
Service	-	Joints	Material	PI, SWP	Valve Type
Domestic					
<u>Water</u>	<u>Sch 80 PVC</u>	Purple Primer/	<u>Sch 80 PVC</u>	<u>600</u>	Full Port
<u>Water</u> <u>Below</u>	<u>Sch 80 PVC</u>	Purple Primer/	<u>Sch 80 PVC</u>	<u>600</u>	<u>Full Port</u> Ball
<u>Water</u> <u>Below</u> <u>Ground</u>	<u>Sch 80 PVC</u>	Purple Primer/	<u>Sch 80 PVC</u>	<u>600</u>	<u>Full Port</u> Ball
Water Below Ground Under	<u>Sch 80 PVC</u>	Purple Primer/	<u>Sch 80 PVC</u>	<u>600</u>	<u>Full Port</u> Ball

Or turf areas Outside of building (2 1/2" and smaller						
<u>3" & above</u>	Sch 80 PVC					
Domestic Cold Water Above Ground	Copper L Hard Drawn	Non-Lead Soldered	Cast Bronze/ Wrought Copper	125	Full Port Ball	
Domestic Hot Water Above Ground	Copper L Tube	Non-Lead Soldered	Cast Bronze/ Wrought Copper	125	Full Port Ball	
Waste Above Ground	Service Weight Cast Iron	Cast Iron	No-Hub	N/A	N/A	
Waste Below Ground Outside and Inside Building	Sch 40 PVC Solid Wall	Purple Primer/ PVC Glue	Sch 40 PVC/DWV	N/A	N/A	
144					1	
vvaste elow Ground Outside and Inside Building	Solid Wall	Purple Primer/ PVC Glue	Sch 40 PVC/DWV	N/A	N/A	
Vent	Galvanized Steel Sch 40/ Cast Iron	Screwed Cast Iron	Wrought Cast Iror No-Hub	N/A	N/A	
Condensate	Hard Drawn type Wrought Copper	Soldered	Cast Bronze	N/A	N/A	

	Sch 40	WeldeD	Malleable Iron or	150/175	Bronze
Fuel Gas	Black Steel		Forged Welding		Taper Plug valve
					Type crewed/Flange

2.11 ASTM DESIGNATIONS FOR PIPE AND FITTING MATERIALS

- A. Pipe shall be stamped and manufactured in "U.S." and shall conform to requirements covered by following ASTM Designations:
 - 1. Steel 40 or 80: A-53, Grade B.
 - 2. Copper Tube "K" and "L": B-88.
 - 3. Cast Iron Waste: A74-80.
- B. Fittings as specified in schedule for various services shall conform to requirements covered by the following ASTM Designations:

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- 1. Malleable Iron: A-197.
- 2. Steel Welding Type: A-234:79a.
- 3. Bronze, Solder-Joint: B-88.
- 4. Wrought Copper, Solder Joint: ANSI B16.22, B16.18.

2.12 MANUFACTURERS OF PIPE AND FITTINGS

- A. All pipe and fittings shall be "U.S." manufactured. Pipe manufacturer shall be submitted for approval. The following manufacturers will be acceptable for materials listed under each group.
 - 1. Steel Pipe
 - a. U.S. Steel Co.
 - b. Republic Steel.
 - 2. Copper Tubing and Fittings
 - a. Muller Brass.
 - b. Chase.
 - c. Revere.
 - d. Cerro.
 - Cast Iron Pipe
 - a. Alhambra.
 - b. Anaheim Foundry.
 - c. U.S. Pipe and Foundry.
 - d. Universal Cast Iron Mfg.
 - PVC Pipe: D1785
 Laboratory Waste
 - Laboratory Waste and Vent Pipe
 - a. Orion.
 - b. Enfield Industrial Corp.

2.13 PIPE JOINTS

3.

- A. Unless otherwise specified, join pipe as follows:
 - 1. All steel pipe two inches (2") and smaller shall have screwed joints.
 - 2. Steel pipe two and one half inches (2-1/2") and larger shall have welded joints.
 - 3. All copper pipe shall have soldered joints made with 95-5 tin/antimony solder.
 - 4. No-Hub Pipe: Neoprene gaskets with stainless steel cinch bands with stainless shield assembly.
 - 5. Galvanized Vent Pipe: For above ground, 2" size and smaller only, with black cast iron drainage fittings.
 - 6. Dissimilar pipes (Copper To PVC): Make transition from PVC to copper at five feet outside the building (or beyond the concrete sidewalk) with schedule 80 T.O.E. Nipples for pipes 2" and smaller, and with PVC to copper flange with brass bolts and nuts for 2 ½" and larger. Wrap joints with "Ten Mil" Polyethylene tape and jacket per ANSI/ AWWA C105.
 - 7. PVC pipe and glue fittings: PVC Purple Primer and PVC Solvent Type Glue.
- B. Joints of Dissimilar Metals: Provide with isolation couplings or dielectric unions of same size as pipe. Where concealed in wall, provide access panel to dielectric unions.
- C. Pipe Make-Up
 - 1. Pipe shall be carefully cleaned before installation. The ends of threaded pipe shall be reamed out fully size with a long taper reamer so as to be partially bell-mounted and perfectly smooth.
 - 2. All threads on black steel pipe shall be cut with new clean dies, full thickness of the die and so that no more than two (2) threads are left exposed on the pipe when the joint is made up in the fitting or valve.
 - 3. Copper, brass pipe and chromed, polished or painted connections from fixtures shall show no tool marks. Make up with approved wrenches.

4. Thread lubricant/sealant shall be used for all threaded, joint make-up and shall be applied to the male threads only. Lubrication/sealant shall include threaded cleanout plugs.

2.14 PIPE SLEEVES, ESCUTCHEONS, COVERS

- A. Furnish and set sleeves to accommodate pipes passing through foundations, walls, floors, partitions, roof; provide one-piece escutcheons at exposed finished surfaces pierced by pipes.
- B. Any pipe passing through a wall of a vertical shaft or through a wall of an occupancy separation or floor shall pass through a 16 gauge steel sleeve. After pipe has been installed through sleeve, remaining space shall be packed tightly with an rated inert packing (3"min. mineral wool) and sealed on both sides with an approved fire stop sealant; and secured each side of wall with an 16 ga. escutcheon around pipe. Submit shop drawings for approval.

2.15 SUPPORTS, HANGERS, INSERTS AND FLASHINGS

- A. Pipe Support: All piping shall be supported in such a manner that it is securely attached to the structure of the building. Attachment is to be capable of supporting the tributary weight of pipe and contents in any direction. Maximum spacing of support and braces shall be as detailed in these specifications.
- B. Support horizontal overhead piping with clevis hangers. Upper end of hanger rod shall be supported from an expansion anchor or similar code approved attachment. See Drawings for pipe support details. Submit shop drawings of all piping supports for approval.

2.16 VALVES TYPES

- A. General: For valve location and installation, refer to "Valves" herein and the Drawings.
- B. Valve Requirements: Unless otherwise indicated or specified for particular system or individual equipment unit, following requirements shall apply:
 - 1. Valves, General: Designed for packing under pressure with valve open or closed.
 - 2. Valves used for throttling of controlling flow: full port ball type as indicated.
 - 3. Full Port Ball valves on all cold tempered and hot water piping unless otherwise noted.
 - 4. Valves shall have rating of not less than 125 psi swp or as indicated in service schedule.
 - 5. Valve Material: Bronze for sizes three inches (3") and smaller.
 - 6. Valve Ends: Screwed for all sizes two inches (2") and smaller, except copper tube.
 - 7. Valve ends for Copper Tubes "K" and "L": Solder joint type.
 - 8. Check Valves: Horizontal swing type with bronze seat and composition or bronze disc as approved; body of same material, pressure rating, screwed or flanged, and finish, as adjoining globe or gate valves. Check valves in pump discharge lines of parallel pumps shall be of the spring loaded <u>non-slam type</u> as manufactured by "Mission" Duo Check Series 150-S-M-F. Submit shop drawings for approval.

2.17 ACCESS PANEL

A. Install where shown and over all concealed valves, cleanouts, isolation unions and any other concealed equipment which may require access for operation, maintenance and repair. Panel shall be sized for proper service not less than twelve inches (12") x twelve inches (12"). Submit Shop Drawings for approval.

2.18 NATURAL GAS SYSTEM

A. ACCEPTABLE MANUFACTURER'S (U.S. MANUFACTURED ONLY):

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- 1. Gas Valves: Stockham, Homestead, Nordstrom, Crane, Rockwell, Mueller, Rockford-Eclipse, Lunkenheimer.
- B. Shut-off Valves:
 - 1. 2" and smaller: Bronze or ferrous body, threaded ends, bronze or ferrous tapered plug. 150 psi W.O.G., for use as natural gas shut-off.
 - 2. 2 ¹/₂" through 4": Cast iron body, flanged ends, bronze bearings, electroless nickel plated cast iron plug with Hycar resilient plug seal, Buna-N stem seal packing, lever actuator, 175 psi W.O.G., for use as natural gas shut-off.
- C. Provide plug valves for all installations.
- D. Gas Pressure Regulators: ANSI Z21.18 or ANSI Z21.18a, single stage, steel jacketed, corrosion-resistant pressure regulators. Include atmospheric vent, elevation compensator, with threaded ends for 2 inches and smaller and flanged ends for 2 inches and larger. Regulator pressure ratings, inlet and outlet pressures, and flow volume in standard cubic feet per hour of natural gas at specific gravity are as indicated:
 - 1. Acceptable Manufacturer's: Equimeter, Fisher, Maxitrol, or equal.
 - 2. Line Gas Pressure Regulators: Inlet pressure rating not less than system pressure.
 - 3. Appliance Gas Pressure Regulators: Inlet pressure rating not less than system pressure, with capacity and pressure setting matching appliance.
 - 4. Gas Pressure Regulator Vents: factory or field installed corrosion-resistant screen in opening when not connected to vent piping.
- E. Flexible Connectors: Not Acceptable.

PART 3 - EXECUTION

- 3.1 INSTALLATION/APPLICATION/PERFORMANCE/ERECTION
 - A. Potable and Industrial Water Piping:
 - 1. Run mains as indicated on the Drawings.
 - 2. Make allowance for expansion in the installation of all piping so that the usual variation in temperature will not cause stress at any point. Securely anchor where necessary to distribute expansion stresses.
 - 3. Arrange new system for complete drainage with 3/4 inch hose valves at low points.
 - 4. Anchor all lines and risers as necessary to prevent noise or vibration when water is turned on or off. Provide Water Hammer Arrestors as necessary.
 - 5. Separately valve each branch and riser. Make all such valves accessible with approved type panels.
 - 6. Where Drawings indicate fixtures as "N.I.C.", provide all rough-in stops; and supplies.
 - 7. Balance, vent and adjust piping to provide circulation to all fixtures and to prevent water hammer.
 - 8. Where indicated on the Drawings, valve, plug or cap pipe ends for future connection.
 - B. Sanitary Piping:
 - 1. Ream all pipe to full diameter after cutting and clean before erection. Run all piping as direct as possible, and conceal piping in finished rooms unless shown or specified otherwise.
 - 2. Install all horizontal sanitary drainage and vent piping of 3-inch diameter and less with a fall of not less than 1/4 inch per foot (2 percent). All horizontal sanitary drainage and vent piping larger than 3-inch may be installed with a fall of not less than 1/8 inch per foot (1 percent) if there is an acceptable justification (structural reasons, etc.) for such variation.

3.2 TESTS/ FIELD QUALITY CONTROL

- A. The following tests shall be made in the presence of the Owner and Architect. Forty-eight (48) hours notification shall be made prior to tests.
- B. Potable Water and Industrial Water Piping Leakage Test:
 - 1. General: After completion of the Work, but before final, acceptance is made, run a test over a four hour period of time to prove that the capacity and performance of all apparatus fittings and the system as a whole meets the requirements of the specifications.
 - 2. Pressure Tests: Start and complete pressure tests in the presence of the Owner/Architect.
 - 3. Cold and hot water services within the Building shall be tested at 120 psi for a period of 4 hours . Any joints showing visible leakage shall be cut out and remade; pening of joints shall not be permitted. Retest sections of pipework containing remade joints.
 - 4. All underground water piping shall be tested to 150 psi pressure for three (3) hours. After tests, water pressure shall be left under supply main pressure for the balance of the construction period.
- C. Sanitary Waste and Vent Piping Leakage Test
 - 1. Start and complete pressure tests in the presence of the Inspection Services.
 - 2. Test all waste drainage piping, including branch bends and ferrule joints, by closing all openings before any fixtures are set and filling the entire system with water, or by air pressure tests as specified below and approved by the Architect.
 - 3. Hydraulically test all underground piping at a minimum static head of 10 feet and to the top of the vent thru roof (VTR) pipes. Leakage at any point in the system shall be cause for rejection.
 - 4. Test TEES shall be installed as necessary and as required for testing of all portions of new underground sanitary waste piping that are connected to the existing waste piping underground.
 - 5. All aboveground piping shall be tested hydraulically by closing all openings in the piping system, except the highest opening above the roof, and by filling the system to the point of overflowing. In no case shall the pressure exerted on -the system be less than 10 feet of head. Leakage at any joint shall be cause for rejection.
 - 6. When it is impractical to test hydraulically, air test may be substituted for hydraulic testing. Forced air into the closed system at a uniform pressure to balance a column of mercury 20 inches in height or a pressure of 10 pounds per square inch gauge.
 - 7. Under any of the previously described tests, the air or water pressure shall remain constant, after stabilization, for not less than fifteen (15) minutes without any further addition of air or water.
- D. Fuel Gas Piping Leakage Test:
 - 1. All fuel gas piping shall be tested to 60 psig, compressed nitrogen, for three hours, without notice of pressure drop.
 - 2. Compressed Air Piping Test: Same as fuel gas.

3.3 STERILIZATION

- A. Perform sterilization of new piping prior to connection to the existing piping and distribution system.
 - 1. The lines and fixtures shall be flushed thoroughly prior to chlorination to remove dirt, etc. Screens on faucets to be removed during injection and replaced after completion of disinfection.
 - 2. Injection shall start only when all fixtures are connected up and ready for operation. All hot, tempered and cold water lines and fixtures to be done where required.
 - 3. A service cock or riser shall be provided by the Plumbing Contractor and located at the

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water service entrance. The disinfecting agent shall be injected into and through the system from these cocks or risers only.

- 4. Chlorine, either gas or liquid, must be used as disinfecting agent. Calcium or Sodium Hypochlorite (liquid or powdered) or as approved in Federal and AWWA procedures may be used.
- 5. The disinfecting agent shall be injected by a proportioning pump or device through the service cock or riser slowly and continuously at an even rate.
- 6. All outlets must be fully opened at least twice during injection and the residual checked with orthotolidine solution.
- 7. When the chlorine residual concentration indicates not less than 50 parts per million at all outlets, then all fixtures and water supply valves must be closed and secured.
- 8. The residual shall be then retained for a period of not less than twenty-four (24) hours.
- 9. After the retention, the residual upon checking at most outlets, shall not be less than ten (10) parts per million. If less, the disinfection must be repeated.
- 10. If satisfactory, then all fixtures must be flushed until residual or orthotolidine tests shall not be greater than the incoming water supply.
- 11. Upon completion of sterilization and flushing, Contractor to obtain a certification of analysis from a state of Nevada licensed laboratory and submit written copy to the Engineer and Inspector. The process shall be repeated if any samples prove unsafe.
- 12. Perform above process for each phase of construction and prior to connecting of that phase to main water loop. Phasing may require multiple disinfection and sterilization process.

3.4 PRIOR TESTS

A. Concealed or insulated work shall remain uncovered until required tests have been completed.

3.5 BALANCE

- A. Hot water return piping shall be balanced to ensure adequate hot water circulation, throughout branches if shown on the drawings. Lock balancing valve after balancing process is preformed.
- B. Refer to drawings for design flow through each hot water return branch.

3.6 WRITTEN REPORTS

A. Written reports, signed and approved by the Contractor's Project Inspector shall be submitted to the Owner to demonstrate compliance for all testing. Final pay request will not be released without submission of this report. No exceptions.

END OF SECTION

PLUMBING SPECIALTIES

PART 1 - GENERAL

- 1.1 DESCRIPTION OF WORK:
 - A. Provide all plumbing specialties as indicated on the Drawings and as specified. Supply fastenings, accessory features, and other items which are necessary to make a complete installation.
- 1.2 QUALITY ASSURANCE:
 - A. Reference Standards: Plumbing and Drainage Institute (PDI) Standard PDI- WH201.

1.3 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Furnish Shop Drawings for all items.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Fixture Carriers
 - 1. Provide Zurn, J.R. Smith, Jonespec or equal fixture carriers.
- B. Water Hammer Arrestors:
 - 1. Precision Plumbing Products (PPP, Inc.), J.R. Smith, Zurn, Fosam, Sioux Chief, Wilkins or equal. ASTM B 88, Type "K" hard drawn copper body, brass piston and threaded connector. Seal lubricant to be Federal Food and Drug Administration approved for use in potable water systems.
- C. Cleanouts
 - 1. Concealed or Exposed in Unfinished Area: J.R. Smith Fig. 4291, Jonespec or equal.
 - 2. Finished Walls: J.R. Smith Fig. 4402, Jonespec or equal, with chrome plated top and satin finish.
 - 3. Finished Floors: J.R. Smith 4031-U-PB, Jonespec or equal, with chrome plated top and satin finish.

PART 3 - EXECUTION

- 3.1 INSTALLATION:
 - A. Install per manufacturer's instruction.

END OF SECTION

PLUMBING SPECIALTIES

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Provide plumbing fixtures approved for water conservation and for handicap regulations.
- B. Provide all trim and appurtenances for proper operation and neat, finished appearance. Procure all rough-in data from manufacturer, and rough-in and connect to fixtures as required.
- C. Refer to the Drawings for relocation of plumbing fixtures.

1.2 QUALITY ASSURANCE:

- A. Applicator (Erector) Qualifications: All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture. Supply all equipment and accessories new, free from defects. All items of a given type shall be the product of the same manufacturer.
- 1.3 REQUIREMENTS OF REGULATORY AGENCIES:
 - A. In all cases where FS, CS, ANSI, NF, NSF or other standards are indicated or required, products shall meet or exceed the standards established for material, quality, manufacture, and performance.
 - B. Fixtures and trim designated for the physically handicapped shall have prior approval of the applicable sections of the ADA Code prior to submissions of Shop Drawings and Product Data. The submission shall contain proof of the required State approvals.

1.4 REFERENCE STANDARDS:

- A. ANSI American National Standards Institute.
- B. ASSE American Society of Sanitary Engineers.
- C. CS Commercial Standards, Commodity Standards Division, U.S. Department of Commerce.
- D. FS Federal Supply Service, Standards Division, General Services Administration
- E. NSF National Sanitation Foundation.

1.5 SUBMITTALS:

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- A. Drawings and Product Data
- B. See Division 1 for requirements and include the following:
 - 1. Descriptive Data
 - a. Plumbing fixtures.
 - b. Plumbing fixture supplies.
 - c. Fixture supports.

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PLUMBING FIXTURES

- 2. Shop Drawings
 - a. Fixture backing.
 - b. Rough-in Drawings.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Ship equipment in its original package,to prevent damage or entrance of foreign matter. Perform all handling and shipping in accordance with manufacturer's recommendations. Provide protective coverings during conversation.

PART 2 - PRODUCTS

- 2.1 ACCEPTABLE MANUFACTURERS:
 - A. Fixtures: American Standard, Kohler, Acorn, Bradley, Elkay or Just.
 - B. Flush Valves: Sloan (Royal) or Zurn, Aqua-flush Z-6000.
 - C. Seats
 - 1. Church
 - 2. Benecke
 - 3. Olsonite
 - D. Supplies
 - 1. American Standard
 - 2. Kohler
 - 3. Crane
 - E. Stops
 - 1. American Standard
 - 2. Kohler
 - 3. Crane
 - F. Traps
 - 1. American Standard
 - 2. Kohler
 - 3. Crane
 - G. Fixture Supports
 - 1. Zurn
 - 2. Smith
 - 3. Wade
 - H. Drains
 - 1. Jonespec
 - 2. J.R. Smith
 - 1. or equal.
- 2.2 MATERIALS:
 - A. Plumbing Fixtures Schedule
 - 1. General: Provide fixtures manufactured by Kohler, Acorn, Bradley American Standard, Eljer, Just or Elkay. See drawings for specifications.

PLUMBING FIXTURES

PART 3 - EXECUTION

3.1 INSTALLATION

A. Plumbing Fixtures:

- 1. Install fixtures as recommended by the fixture manufacturer except as shown differently on Drawings or where required by ADA.
- 2. Set fixtures level and equally spaced when installed in bank of more than two.
- 3. Rough-in supplies level, equally spaced and symmetrical with the fixture.
- 4. Rough-in wastes in alignment with the fixture drain. Off-setting trap and waste will not be acceptable. Install flush valves level with flush connections vertically. Offsetting and misalignment will not be acceptable.
- 5. Caulk with 100% mildew resistant silicone rubber sealant all deck mounted trim at the time of assembly, including fixture and casework mounted. Caulk all self-rimming sinks installed in casework. The butted space between fixtures and the wall, counter or floor on which they are mounted shall be sealed with white mildew resistant 100% silicone rubber caulking compound. See Division 7.
- 6. Point up fixtures at joints with walls and floors with non-hardening Tile-Fix.
- 7. Cover exposed fixture fastening nuts and bolts with china bolt caps. Fill with putty.
- 8. Make up trim with care and with the proper tools in order that no tool marks show after installation.
- B. Water Supplies:
 - 1. Provide each water supply to each fixture, equipment or faucet with a stop in the branch connecting thereto. The stop shall be a loose key stop at finished wall locations and a rough brass globe valve at rough locations. Angle stops for deck mounted faucets shall have an IPS inlet.
 - 2. Cover unoccupied fixture faucet holes with chrome faucet hole covers.
 - 3. Securely fasten screwed adaptor fittings behind water supply stubouts to the structure.
- C. Waste Outlets: Bed strainers set in sanitary waste fixtures with glazing or plumbers putty.
- D. Supports:
 - 1. Support wall-hung sinks and lavatories by concealed chair carriers, commercial type, with block feet and thrust nuts. Securely anchor the carrier to the structure.
 - 2. Bracket all other wall mounted fixtures to 12-gauge steel plates, fastened to face of steel studs, with metal screws, and with bracket screwed to backing.
 - 3. Bolt chair carrier foot anchors and rear lugs to floor.
 - 4. Add flushometer support arms that attach to wall.
 - 5. Coordinate wall dimensions required.

3.2 ADJUSTMENT AND CLEANING:

A. In accordance with the requirements of Sections15050.

END OF SECTION

PLUMBING FIXTURES

HYDRONIC PIPING

PART 1 - GENERAL

- 1.1 WORK DESCRIPTION
 - A. Provide hydronic water piping for the air conditioning systems as indicated on the Drawings and as specified.

1.2 RELATED WORK

- A. Section 09900 Painting.
- B. Section 15121 Piping Expansion Compensation.
- C. Section 15190 Mechanical Identification.
- D. Section 15240 Vibration Isolation And Seismic Control.
- E. Section 15250 Mechanical Insulation.

1.3 REFERENCES

- A. ASME B31.9 Building Services Piping.
- B. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
- C. ASTM B88 Seamless Copper Water Tube.
- D. AWS D1.1 Structural Welding Code.

PART 2 - PRODUCTS

- 2.1 MATERIALS
 - A. Hydronic Water Piping
 - 1. Pipe: Schedule 40 black steel pipe ASTM A-53 Grade B.
 - 2. Fittings
 - a. 2" and smaller: 150 psig. black malleable iron screwed fittings, ANSI B16.3.
 - b. 2-1/2" and Larger: Standard weight seamless, carbon steel, standard radius butt welding fittings, ASTM A 106, Grade A or grooved and mechanical joint type.
 - c. "Full Flow" fittings Style 07, or equal (no known equal).
 - 3. Unions: 150 psig. black malleable iron with brass to iron seating on piping 2" and smaller.
 - 4. Flanges
 - a. 150 psig. Forged: Steel, slip-on or weld-neck, ANSI 816.5, ASTM A-181, Grade I, on piping 2-1/2" and larger.
 - b. Flanges are not required on groove type joint fittings except for make-up to flanged valves or equipment.
 - c. Gasket: 1/16" thick preformed neoprene bonded.

HYDRONIC PIPING

- 5. Copper Tubing: ASTM B88, Type L, hard drawn.
 - a. Fittings: ANSI/ASME B16.23 cast brass of ANSI/ASME B16.29 solder wrought copper.
 - b. Joints: ASTMB32, solder, Grade 95TA.
- B. Condensate Drains from Cooling Coils
 - 1. Pipe:
 - a. Seamless copper tubing, Type L, cold drawn, hard temper, ASTM B-88.
 - b. Exposed to view at plumbing fixtures and finished equipment; satin finish CP brass pipe with threaded cast bronze fittings,.
 - 2. Fittings: Wrought copper solder sweat type, ANSI B16.22 or brass castings, ANSI B16.18.
 - 3. Flanges: Standard weight brass castings bronze, ANSI B16.24.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Water Piping
 - 1. Run piping as indicated on the Drawings.
 - 2. Make allowance for expansion in the installation of all piping so that the usual variation in temperature will not cause undue stress at any point. Securing anchor pipes where necessary to properly distribute expansion stresses.
 - 3. Use eccentric fittings for all changes in pipe sizes of supply and return lines arranged to prevent trapping of air, except where reducing tees are used.
 - 4. Install flanged elbows for water connections to equipment with heat exchangers to allow easy removal of tube bundles. Place no obstruction in space required for tube removal.
 - 5. Provide high points with air chambers and manual air vents with 1/4-inch copper tube vent line and stop cock carried to accessible point and away from pipe insulation.
- B. Valves and Strainers
 - 1. General: Unless shown otherwise provide valves at each piece of equipment to provide isolation of the equipment from its connected system. Locate strainers and valves as necessary to provide easy isolation and cleaning of strainers.
 - 2. Unless shown otherwise, provide a check valve, and gate valve, in the discharge line and a strainer and gate valve in the suction line of each circulating pump.
 - 3. Provide equipment with automatic control valves with ball or butterfly valves installed either ahead or behind the control valve, to permit removal of the control valve from the line without draining the system.
 - 4. Provide "eccentric plug valves" for balancing valves.
 - 5. Provide top level eccentric reducers on pump suction inlets.
 - 6. Provide ball valve or butterfly valves for isolation.
- C. Accessories
 - 1. Pressure Gauges: Install pressure gauges across all pumps to indicate total pumping head. Gauges shall be of range required for pumping head and system static head. Install one gauge (each) at pump suction and discharge piping.
 - 2. Provide the following where shown on the Drawings and where specified:
 - a. Flow Indicators
 - b. Thermometers
 - c. In-line Flexible Pipe Isolators

3.2 FIELD QUALITY CONTROL

A. Piping System Leak Tests

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HYDRONIC PIPING

- 1. Make pressure tests in the presence of the Owner/Architect .
- 2. Pressure test at 125 psig (860 kPa) or 150 percent of the operating pressure, whichever is greater. If found that any portion of the system does not function, make corrections as approved.
- 3. Perform all pressure tests with the use of a Bristol Recording Gage, and record of all tests kept for hand-over to the Owner.
- B. Do not use pumps to support piping and fittings.

3.3 ADJUSTMENT AND CLEANING

- A. Preparation of Water Systems for Balancing: Provide a Testing Agency to prepare the water systems for balancing in the following manner after completion of the air balance described hereinafter:
- B. All normally open valves shall be in full open position.
- C. Water in system shall be examined to determine if water has been treated and cleaned.
- D. All screens in strainers shall be removed and cleaned. Flushing screens should be removed and set next to pumps.
- E. Correct pump rotation shall be verified.
- F. Expansion tanks shall be checked to determine they are not air bound and the system is completely full of water with no air pockets blocking water flow. Check all air vents to release air and ensure no air binding is present.
- G. Proper operation of all automatic valves shall be verified.
- H. Operating temperature of convectors shall be verified and set to design requirements.

END OF SECTION

HYDRONIC PIPING

CHEMICAL (WATER) TREATMENT

PART 1 - GENERAL

- 1.1 WORK DESCRIPTION
 - A. Cleaning of piping systems.
 - B. Chemical treatment.

1.2 RELATED WORK

A. Section 15510 – Hydronic Piping.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit product data indicating chemical treatment materials, and chemical.
- B. Submit manufacturer's installation instructions.
- C. Submit manufacturer's field reports.
- D. Submit reports indicating start-up of treatment systems is completed and operating properly.
- E. Submit reports indicating analysis of system water after cleaning and after treatment.
- F. Submit manufacturer's qualifications as outlined in 1.6.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs.
- C. Include step-by-step instructions on test procedures including target concentrations.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum ten years of experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

1.7 REGULATORY REQUIREMENTS

A. Conform to EPA code for additional of non-potable chemicals to building mechanical systems, and for delivery to public sewage systems.

1.8 WARRANTY

A Provide one (1) year manufacturer's on-site warranty including parts and labor beyond substantial Completion of the Project.

1.9 MAINTENANCE, SERVICE AND EMERGENCY SERVICE

A. Submit reports of maintenance and emergency services to include descriptions of malfunctions and repairs or replacements made.

1.10 MAINTENANCE MATERIALS

A. Submit maintenance materials.

PART 2 - PRODUCTS

- 2.1 MATERIALS
 - A. System Cleaner
 - 1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products, sodium tripoly phosphate and sodium molybdate.
 - 2. Algaecide, chlorine release agents such as sodium hypochlorite or calcium hypochlorite, or microbiocides such as quarternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate), or isothiazolones.
 - B. Closed System Treatment (Water)
 - 1. Sequestering agent to reduce deposits and adjust pH, polyphosphate.
 - 2. Corrosion inhibitors, liquid boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
 - 3. Conductivity enhancers, phosphates or phosphonates.

2.2 TEST EQUIPMENT

- Provide white enamel test cabinet with local and fluorescent light, capable of accommodating 4
 10 ml zeroing titrating burettes and associated reagents.
- B. Provide the following test kits:
 - 1. Alkalinity titration test kit.
 - 2. Chloride titration test kit.
 - 3. Sulphite titration test kit.
 - 4. Total hardness titration test kit.
 - 5. Low phosphate test kit.
 - 6. Conductivity bridge, range 0 10,000 microhms.
 - 7. High nitrite test kit.

2.3 MANUFACTURERS/PROVIDERS

- A. Chem Aqua. Inc.
- B. Chem Treat, Inc.
- C. Ondeo Nalco
- D. Pacific Water Consultant
E. San Joaquin

PART 3 - EXECUTION

3.1 PREPARATION

- A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- B. Place terminal control valves in open position during cleaning.

3.2 CLEANING SEQUENCE

- A. Heating Water System
 - 1. Add cleaner to closed systems at concentration as recommended by manufacturer.
 - 2. Apply heat while circulating, slowly raising temperature to 160° F. and maintain for 12 hours minimum. Remove heat and circulate to 100° F. or less; drain systems as quickly as possible and refill with clean water. Circulate for 6 hours at design temperatures, then drain. Refill with clean water and repeat until system cleaner is removed.
- B. Use neutralizer agents on recommendation of system cleaner supplier and approval of Owner.
- C. Flush open systems with clean water for one hour minimum. Drain completely and refill.
- D. Remove, clean, and replace strainer screens.
- E. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- 3.4 CLOSED SYSTEM TREATMENT (HOT WATER)
 - A. Introduce closed system treatment through bypass (Pot) feeder when required or indicated by test.

END OF SECTION

HEAT PUMP ROOFTOP

PART 1 - GENERAL

- 1.1 GENERAL
 - A. Comply with the requirements of Section 15050.

1.2 SECTION INCLUDES

- A. Packaged rooftop heat pump units.
- B. Controls.
- C. Accessories.
- 1.3 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION
 - A. Division 16 Electrical: Equipment Wiring Systems Installation and wiring of thermostats and other controls components.
- 1.4 RELATED SECTIONS
 - A. Section 15170 Motor and Variable Frequency Drive.
 - B. Section 15240 Vibration Isolation and Seismic Controls.
 - C. Section 15250 Mechanical Insulation.
 - D. Division 16 Electrical: Equipment Wiring Systems Electrical supply to units.

1.5 REFERENCES

- A. ANSI/NFPA 90A Installation of Air Conditioning and Ventilation Systems.
- B. ARI 21 0 Unitary Air Conditioning Equipment.
- C. ARI 270 Sound Rating of Outdoor Unitary Equipment.

1.6 SUBMITTALS

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Submit shop drawings and product data under provisions of Section 15050 and Division 1.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 15010 and Division 1.
- C. Include manufacturers' descriptive literature, operating instructions, installation instructions maintenance and repair data, and parts listing.

HEAT PUMP ROOFTOP

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 15050 and Division 1.
- B. Store and protect products under provisions of Section 15050 and Division 1.
- C. Protect units from physical damage by storing off site until roof mounting frames are in place, ready for immediate installation of units.

1.9 WARRANTY

- A. Provide five year manufacturer's warranty under provisions of Section 15050 and Division 1.
- B. Warranty: Include coverage of refrigeration compressors.

1.10 MAINTENANCE SERVICE

- A. Provide maintenance service with a two month interval as maximum time period between calls. Provide 24-hour emergency service on breakdowns and malfunctions.
- B. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of six filter replacements, minimum of one fan belt replacement, and controls check-out, adjustments, and recalibrations.
- C. Submit copy of service call work order or report, and include description of work performed.

1.11 EXTRA MATERIALS

A. Provide one set of filters under provisions of Section 15050 and Division 1

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Carrier.
- B. Daikin.
- C. Substitutions: Under provisions of Section 15050 and Division 1.

2.2 PACKAGED ROOFTOP HEAT PUMP UNITS

- A. Furnish and install combination package heating-cooling heat pump units with full economizer cycle, power exhaust and capacities as scheduled on the drawings. Heat pump units shall be complete with circulating blower, combination heating-cooling coil, insulated compressor compartment, hermetically sealed heat pump duty compressor, air cooled condenser, condenser blower or fan, automatic controls, control panel with starters, relays, etc., within a weatherproof, insulated decorative casing. Units shall be furnished with filters as scheduled.
- B. The system shall be complete with provisions for automatic defrost and be able to make an automatic changeover from heating to cooling and vice versa. Unit shall be completely factory wired for terminal connections of thermostat with a fan-on-auto-off switch and a system heat-cool switch. Units shall be installed in strict accordance with manufacturer's recommendations,

HEAT PUMP ROOFTOP

complete with manual outside air damper package, prefabricated roof curb and all necessary accessories for efficient and proper operation, Unit shall be provided with low ambient kit.

2.3 CONTROLS

Provide low voltage, adjustable heating/cooling thermostat to control units.

- A. Include system selector switch (heat-off-cool) and fan control switch (auto-on).
- B. Locate thermostats as shown on the drawings.
- C. Electrical contractor will provide back box, conduit, and conductors. HVAC contractor shall mount thermostat, make final connections and verify proper operation.

2.4 ACCESSORIES

For packaged systems include the following:

- A. Outside and exhaust air backdraft damper.
- B. Filters.
- C. Min. 14" high full perimeter roof curb.
- D. Thermostat and subbase.
- E. Additional items as scheduled and/or detailed on the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that roof is ready to receive work and opening dimensions are as illustrated by the manufacturer.
- B. Verify that proper power supply is available.

3.2 INSTALLATION

- A. 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 frame level.

3.3 MANUFACTURER'S FIELD SERVICES

A. Provide initial start-up and shut-down during first year of operation, including routine servicing and check-out.

END OF SECTION

HEAT PUMP ROOFTOP

FANS

PART 1 - GENERAL

1.1 WORK DESCRIPTION

- A. Provide centrifugal, propeller, axial flow type fans as indicated on the Drawings and as specified.
- B. Section Includes
 - 1. Backward inclined centrifugal fans.
 - 2. Forward curved centrifugal fans.
 - 3. Motors and drives
 - 4. Fan Accessories.
 - 5. Utility centrifugal exhaust fan.

1.2 RELATED WORK

- A. Section 15170 Motor and Variable Frequency Drive.
- B. Section 15240 Vibration Isolation and Seismic Controls.

1.3 REFERENCES

- A. AMCA 210 Laboratory Methods of Testing Fans for Rating Purposes
- B. AMCA 300 Test Code for Sound Rating Air Moving Devices.
- C. NEMA MG1 Motors and Generators.
- D. NFPA 70 National Electrical Code.
- E. SMACNA HVAC Duct Construction Standards Metal and Flexible.

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Test and rate all fans in accordance with Air Movement and Control Association, Inc. (AMCA) Standard 210. Fans shall bear the AMCA label.

1.5 SUBMITTALS

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Submit complete fan performance curves marked to indicate selection points for proposed fans. Include with data submitted sound power levels in all octave bands.
- C. Submit for all fans, manufacturer's literature indicating details of construction, size, motor horsepower, and brake horsepower.
- D. Submit factory dynamic balance test report for completely assembled fans. The report shall detail the exact level of vibration recorded on the fan.

E. Submit tests in accordance with Paragraph 3.2.

1.6 **OPERATION AND MAINTENANCE DATA**

- Submit under provisions of Division 1. Α.
- Β. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.7 DELIVERY STORAGE AND HANDLING

- Deliver, store, protect and handle products to site under provisions of Division 1. Α.
- Β. Protect motors, shafts, and bearings from weather and construction dust.

WARRANTY 1.8

- Α. Provide one (1) year manufacturer's on-site warranty including parts and labor.
- Β. Provide five (5) year parts and labor warranty coverage for motor and drive assemblies.

1.9 MAINTENANCE AND EMERGENCY SERVICE

- Α. Provide regular maintenance for the contract period from start up of the equipment through completion of the 12-month warranty period. Maintenance service for equipment shall be provided based on the manufacturer's recommendations, but at least every two months.
- Β. Regular maintenance shall include a minimum of six filter replacement and a minimum of one drive belt replacement.
- C. Provide 24-hour emergency service for breakdowns and malfunctions. An emergency number shall be provided to the owner. A call back response shall be within four (4) hours of the phone call.
- D. Submit reports of maintenance and emergency services to include descriptions of malfunctions and repairs or replacements made.

MAINTENANCE MATERIALS 1.10

- Α. Division 1- Contract Closeout, Operation and Maintenance Data.
- Β. Provide two containers of lubricating oil and refrigerant.

1.11 REGULATORY REQUIREMENTS

- Provide certification of inspection for conforming authority having jurisdiction. Α.
- Β. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.
- C. Fabrication: Conform to AMCA 99.
- D. Performance Base: Sea level conditions.
- E. Temperature Limit: Maximum 300 degrees F
- F. Static and Dynamic Balance: Eliminate vibration or noise transmission to occupied areas.

2.2 MATERIALS

- A. Roof Exhausters Centrifugal Type
 - 1. Provide centrifugal type roof exhausters of the type, wheel size and capacity scheduled on the Drawings. V-belt drives shall be as specified in Section 15050 and shall have adjustable pitch motor sheave. Motor shall be mounted on adjustable base.
 - 2. Housing shall be fully weatherproofed. Outlet shall be provided with a removable bird screen. Motor and fan assembly shall be on vibration isolating mounts.
 - 3. Fan bearings shall be ball bearing type and provided with means of lubrication.
 - 4. Fan housing shall be easily removable for access to all parts.
 - 5. Dampers shall be gravity type manufactured by the fan manufacturer.
 - 6. Manufacturers: Cook, Carnes, Greenheck.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Install fans and accessories in accordance with manufacturer's printed instructions.
- 3.2 The Contractor is responsible for changing belts, sheaves and/or motors to correct building air balance as UNIT TEST
 - A. recommended by the Engineer.
 - B. The fans shall be factory run tested to insure structural integrity. The factory run test shall be conducted to examine unit operation and minimum vibration levels as specified.
 - C. The following tests shall be performed:
 - 1. Unit operation and vibration analysis. The unit fans shall be operated at the unit design RPM and a complete vibration spectrum shall be conducted as specified in the section covering unit fan. Any fan, motor, drive and base assembly vibration shall be brought to within specified levels. Fan tests as conducted in the fan supplier's shop are not acceptable.
 - 2. A sound performance test shall be made on one of each type of exhaust fan prior to shipment of any air handler. The test shall be performed in an AMCA certified laboratory. The particular fan to be tested shall be at the discretion of the Owner/Architect. The octave band sound power levels shall be determined in accordance with an ANSI
 - 3. Standard procedure. Data shall be taken to verify, at the unit's full flow CFM and static pressure for the exhaust fan sound power levels. Test results to be submitted to Architect for approval prior to shipment of any equipment.
 - D. Commissioning Agent shall perform functional performance test to confirm that the system

performs to the extent of the design intent.

END OF SECTION

AIR CLEANING

PART 1 - GENERAL

1.1 WORK DESCRIPTION

A. Provide all materials for the cleaning and filtering of the air supply as indicated on the Drawings and as specified.

1.2 REFERENCES

- A. ARI 850 Commercial and Industrial Air Filter Equipment.
- B. ASHRAE 52 Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- C. NFPA 70 National Electrical Code.
- D. UL 586 Test Performance of High Efficiency Particulate, Air Filter Units.
- E. UL 900 Test Performance of Air Filter Units.

1.3 QUALITY ASSURANCE

A. All panel and extended surface air filters to be tested and rated in accordance with the ASHRAE Test Method Standard 52-76.

1.4 SUBMITTALS

A. Submit shop drawings and product data for filters and filter holding frames.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Bag Filters
 - 1. Air filters shall be high efficiency ASHRAE extended surface pocket style filters consisting of high loft air laid microfine glass media, a galvanized steel header, galvanized steel pocket retainers, and bonding agents to prevent air bypass and ensure leak free performance.
 - 2. Sizes shall be as noted on drawings or other supporting materials.
 - 3. Filter media shall consist of high-density air laid lofted microfine glass media that is chemically bonded to a permeable media support backing forming a lofted filter blanket.
 - 4. Individual pockets shall contain a minimum of 40 stitching support points per square foot of media area. All stitching centers shall be sealed through the use of a foam based sealant that shall remain pliable throughout the life of the filter. The sides and ends of each pocket shall be sewn with a chain-link over lock stitch.
 - 5. Pockets shall be formed into tapered pleats, supported by controlled media space stitching, to promote uniform airflow across the surface of the media. At any point, the sizes of the upstream and downstream passages shall be proportional to the volume of filtered air.

AIR CLEANING

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- 6. Support members shall include a galvanized steel header and galvanized steel pocket retainers. The header shall be bonded to the media to prevent air bypass. Individual pocket retainers shall be fastened with a mechanical crimp to lock individual pockets together. The media pockets shall be bonded to the pocket retainers to prevent air bypass. The frame shall form a rigid and durable support assembly.
- 7. A filter-to-filter sealing gasket shall be installed on one of the vertical members of the filter header.
- 8. The filter shall have a Minimum Efficiency Reporting Value of MERV 11 per ASHRAE Standard 52.2-1999.
- 9. The filter shall be capable of withstanding 5.0" w.g. without failure of the filter.
- 10. The filter shall be classified by Underwriters Laboratories as UL Class 2.
- 11. Manufacturer shall provide evidence of facility certification to ISO 9001:2000.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all air cleaning devices in accordance with approved shop drawings and the manufacturer's printed recommendations.
- B. Install differential magnahelic pressure gauges across each filter bank.
- C. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
- D. Do not operate fan system until filters (temporary) are in place. Replace temporary filters used during construction.
- E. Install filter gage static pressure tips upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum, in accessible position. Adjust and level.

3.2 TEMPORARY FILTERS

- A. Provide 2 sets of 4-inch thick temporary disposable-type filters for use during construction in place of all permanent filters.
- B. After completion of work and as directed by the Architect and before final testing and balancing of the air handling systems, provide the specified permanent filters.

END OF SECTION

DUCTWORK

PART 1 - GENERAL

- 1.1 WORK DESCRIPTION
 - A. Low pressure ducts.
 - B. Duct cleaning.

1.2 REFERENCES

- A. ASHRAE Handbook Fundamentals; Duct Design.
- B. ASHRAE Handbook Equipment; Duct Construction.
- C. ASTM A 90 Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- D. ASTM A 167 Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- E. ASTM A 525 General Requirements for Steel Sheet, Zinc- Coated (Galvanized) by the Hot-Dip Process.
- F. ASTM A 527 Steel Sheet, Zinc-Coated (Galvanized) by Hot- Dip Process, Lock Forming Quality.
- G. NFPA 90A Installation of Air Conditioning and Ventilating Systems.
- H. NFPA 96 Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooling Equipment.
- I. SMACNA HVAC Duct Construction Standards.
- J. UL 181 Factory-Made Air Ducts and Connectors.

1.3 SUBMITTALS

- A. Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work supply and exhaust ductwork.
- B. Submit full duct shop drawings for all areas of the building detailing all duct equipment, duct and control devices. Drawings shall be 1/4" scale and shall show ductwork and all devices therein mounted. Upon approval of these drawings, copies shall be provided to the TABA.

1.4 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

1.5 DELIVERY STORAGE AND HANDLING

A. Deliver products to site under provisions of General Conditions and Division 1 as applicable.

B. Store and protect products under provisions of General Conditions and Division 1 as applicable.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Non-combustible or conforming to requirements for Class 1 air duct materials and UL 181.
- B. Steel Ducts: ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz per sq ft for each side in conformance with ASTM A90.
- C. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction or fabric supported by helically wound spring steel wire or flat steel bands; rated to 2 inches WG positive and 1.5 inches WG negative for low pressure ducts and 15 inches WG positive or negative for medium or high pressure ducts.
- D. Insulated Flexible Ducts: Flexible duct wrapped with flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K value at 75 degrees F.
- E. Fabricate and support in accordance with SMACNA Low Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- F. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.
- G. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- H. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- I. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.
- J. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- K. Use double nuts and lock washers on threaded rod supports.

2.2 SEAMS AND JOINTS

- A. Longitudinal seams shall be Pittsburgh, or equal (no known equal) lock with 3/8 inch minimum pocket.
- B. Round Ductwork: Transverse joints in low pressure round ducts to be beaded sleeve joint (SMACNA) secured with sheet metal screws equally spaced on 6 inch centers maximum with a minimum of 3 screws per joint. Round duct elbows shall be stamped or segmented; adjustable elbows are not acceptable. Seal joints with sealant.

- C. Rectangular Ductwork: Construct all seams and joints in rectangular ductwork in accordance with of the SMACNA "HVAC Duct Construction Standards." Seal all transverse joints with duct sealant.
- D. Seal each duct transverse joint and longitudinal seam with a duct sealant. Use hardcast DT tape with RTA adhesives or equal (no known equal), for exterior ductwork.

2.3 FITTINGS

- A. Elbows: All elbows shall have an inside radius not less than the width of the ducts in the direction of the curve. Where space conditions do not permit a full radius elbow, changes in direction shall be made using mitered elbows with multiple double thickness turning vanes.
 - 1. Construct radius elbows in accordance with "HVAC Duct Construction Standards." Short radius elbows are not allowed.
 - 2. Construct vaned elbows of double vanes in accordance with "HVAC Duct Construction Standards." Single vane elbow shall not be used.
- B. Construct transitions and offsets in accordance with the "HVAC Duct Construction Standards,"
 - 1. Transitions: Maintain full duct cross section areas through transitions. Angle between centerline and side of diverging transition shall be no greater than 15 degrees in lieu of 20 degrees shown in the "Low Pressure Duct Manual." Angle between centerline and side of converging transition shall be no greater than 30 degrees.
 - 2. Offsets: Construct with inside radii not less than the width of the duct in the direction of the curbs. Mitered elbows as specified under Subparagraph, "Elbows," herein may be used where space is restricted.
- C. Collar taps for air outlet connections on exposed ductwork to be made with joint connection folded over inside of main duct and without exposed flanges. Outlet collar to be of same dimension as outside dimension of air outlet frame.
- D. Make branch connections in accordance with SMACNA and as otherwise indicated on the Drawings.
- E. Outlet Frames: Where ducts terminate at grilles, registers or diffusers, furnish with angle or channel iron frames with mitered welded corners and with provisions for attaching said grilles, registers, or diffusers.
- F. Access Doors: Hinged, airtight, access doors shall be provided where required for access to control elements or for inspection. Size doors for maintenance of concealed items. Construct access doors in accordance with "HVAC Duct Construction Standards." Furnish hinged doors except where space does not allow the door to swing open furnish removable doors. Insulate access doors where ducts are insulated with same insulation as on ductwork or housing.
- G. Make connections between ductwork and outlets with flexible duct material herein specified.

2.4 FLEXIBLE DUCTWORK

- A. Provide flexible duct as indicated and make connections between rigid ducts and terminal boxes with a minimum of 24 inches of flexible ductwork. No flexible duct to be longer than 5 feet. There shall be no more than the equivalent of one (1) full radius, 90° elbow, in a section of flex duct.
- B. Flexible ductwork shall be factory pre-insulated of spiral construction composed of a corrosion resistant metal supporting spiral and a coated fabric with a metal or mineral base. Flexible duct connectors to be class 1 listed by Underwriters Laboratories Inc. (UL) and shall have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50. Operating

temperature range shall be 0 to 200 degrees F. operating pressure to be negative 0.5 inch to positive 10-inch water gage (W.G.).

- C. Flexible ductwork shall be in accordance with SMACNA.
- D. Flexible ductwork shall be supported in accordance with SMACNA.
- E. Flat oval ductwork shall be constructed in accordance with SMACNA.
- F. Round ductwork shall be constructed in accordance with Figures 3-1 to 3-5.

2.5 FLEXIBLE CONNECTIONS

A. Install six-inch flexible connections between all rigid ductwork or casing and all air handling equipment. Connections shall be of fireproof material and shall withstand temperatures and pressure involved. Connections on exhaust fans shall be a chemical resistant material. Allow at least 1 inch slack in these connections to insure that no vibration is transmitted from fan to ductwork. The fabric shall either be folded in with the metal or attached with metal collar frames at each end to prevent air leakage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- B. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- C. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
- D. Connect diffusers to ducts with 5 feet maximum length of flexible duct where indicated on drawings. Hold in place with strap or clamp.
- E. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- F. Adhere to Drawings: Run and shape of ducts offsets during progress of work may be varied, if required to meet structural or other interferences, as approved.
- G. Install ductwork in adherence to ceiling height shown on Drawings. Establish necessary space requirements so as to maintain required clearances around all equipment.
- H. Reinforce all ducts to prevent buckling, breathing, vibrations or noise, such reinforcing shall be as recommended in the reference specified herein.
- I. Fire resistant, plenum rated, material flags, shall be installed at all duct mounted devices utilized for adjustment or requiring service.

3.2 DUCTWORK APPLICATION SCHEDULE

AIR SYSTEM SUPPLY RETURN AND RELIEF GENERAL EXHAUST MATERIAL GALVANIZED STEEL GALVANIZED STEEL GALVANIZED STEEL

3.3 CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. Do not exceed rated pressure of ductwork. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- B. Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.
- C. Clean all duct interiors of all debris.

3.4 ADJUSTMENT AND BALANCING

A. Make adjustments of the mechanical equipment in accordance with the Plans and Specifications as necessary, so the air balance testing agency which will be contracted by the Owner can complete its work. If it is found that any portion of the Work has not been installed as specified for accomplishing the testing and balancing as called for in the Specifications, the Work shall be redone at no additional cost.

END OF SECTION

DUCTWORK

DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 WORK DESCRIPTION

A. Provide ductwork accessories complete for the air distribution system, as indicated on the Drawings and as specified.

1.2 SUBMITTALS

- A. Submit the following items:
 - 1. Flexible connections.
 - 2. Volume dampers.
 - 3. Diffusers, registers and grilles.
 - 4. Motorized dampers.
 - 5. Duct access doors.
 - 6. Back draft dampers.
 - 7. Test holes.

1.3 QUALITY ADSSURANCE

A. Construct ductwork to NFPA 90A and NFPA 90B standards.

PART 2 - PRODUCTS

- 2.1 MATERIALS
 - A. Flexible Connections: Six-inch flexible connections shall be installed between all rigid ductwork or casing and all air handling equipment. Connections shall be of fireproof material and manufactured for temperatures and pressures involved. Allow at least 1 inch slack in these connections to insure that no vibration is transmitted from fan to ductwork. The fabric shall either be folded in with the metal or attached with metal collar frames at each end to prevent air leakage. Material shall be "Ventglas" by Ventfabrics, Inc., Vibration Mounting and Controls, Inc. 1. Flexibles at roof fans.
 - 2. Acoustic floor.
 - 2. Acoustic floor.
 - B. Volume Dampers
 - 1. Provide Volume Damper (VD) at each branch duct and as indicated on Drawings for supply, return, and exhaust air duct systems. Provide five (5) diameters distance from first outlet/inlet.
 - 2. Comply with SMACNA "Side Elevation" and Text on Volume Dampers" for all details except as specified herein on single blade and two bladed damper for 2" W.G. Class duct. Provide each damper with a closed end bearing. 3. Use 3/8" continuous square rod and 18 gauge galvanized stiffened blade for damper blade sizes 18" wide by 18" high and smaller or 12" diameter and smaller.
 - 4. Use 1/2" continuous square rod and 16 gauge galvanized stiffened blade for damper blades sizes 19" to 48" wide by 10" high. Maximum blade size is 48" by 10" high. Maximum diameter is 16".
 - 5. Maximum of two blades without a frame: Over two blades, use a manufactured 16 gauge galvanized, stiffened, opposed blade damper in a 14 gauge galvanized steel frame. Galvanize all hardware except use brass trunions and bronze oilite bearing; Pacific Air Products, Series 200; Puttorff Series 400.

- 6. Quadrant shall be Durodyne Model 3/8" K-4/1/2" K-5 Quadline; Ventlox Model 555 Ventline.
- 7. Provide closed end bearing, Durodyne SB-338 (3/8")/SB-312 (1/2"); Ventlox Model 609.
- 8. Cut slot in end of damper rod (Quadrant End) to indicate blade position.
- 9. Provide galvanized sheet metal "hat section" on ducts with exterior insulation so that quadrant will be exposed.
- 10. Install each square rod vertical or horizontal so that quadrant shall be accessible for adjusting.
- 11. Provide 24" x 24" access for each volume damper, and fire dampers that is not accessible as approved by Owner.
- 12. Remote operated dampers VD(R), shall be operated via Young Regulators (or equal, No known equal).
- 13. Provide additional dampers required for correct balance as recommended by the test agency, which will be installed by the Contractor at no additional cost.
- C. Duct Test Holes
 - 1. Cut or drill temporary test holes in ducts as required. Cap with threaded metal caps.
 - 2. Permanent test holes shall be factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.
- D. Duct Access Doors: Hinged, airtight, access doors shall be provided where required for access to control elements or for inspection. Doors shall be sized for maintenance of concealed items. Construct access doors in accordance with SMACNA "Low Pressure Duct Manual." Furnish hinged doors except where space does not allow the door to swing open. Furnish removable doors. Insulate access doors where ducts are insulated with same insulation as on ductwork or housing.
- E. Motorized Dampers
 - 1. Dampers shall be provided for outside air as shown on the Drawings.
 - 2. Damper frames shall be 16 gauge galvanized steel hat channels. Blades shall be 18 gauge galvanized steel, 7-1/4 inch width, maximum length 48 inches. Axles shall be 1/2 inch diameter galvanized steel stub. Bearings shall be heavy duty self-lubricating nylon.
 - 3. Dampers shall be low leakage, opposed blade type. Pressure drop for opposed blade dampers shall not exceed .55 inch W.G. at the full open position and at the face velocity of 3000 FPM.
 - 4. Dampers shall be internally mounted driven with blades.
 - 5. Dampers shall be low leakage type. Damper blades shall be equipped with dual duometer vinyl seals. Jambs shall have metallic compression seals. Leakage shall not exceed 4-5 cfm per square foot at 2 inch w.g. differential pressure.
- F. Backdraft Dampers
 - 1. Gravity silent type backdraft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturer's standard construction.
 - 2. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of 16 gage stainless steel with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.
- G. Acoustic Flexible Connectors: Acoustic flexible ducts shall be listed by Underwriters' Laboratories under UL Standard 181 as Class I flexible air duct and complying with NFPA Standards 90A and 90B. Duct shall be factory-made and composed of a CPE liner duct permanently bonded to a coated spring steel wire helix and supporting a fiberglass insulating blanket with fiberglass scrim. Low permeability outer vapor barrier shall complete the assembly.

- H. Diffusers and Registers
 - 1. Ceiling Supply Diffusers: Removable face, flush-mounted, horizontal supply, air pattern rectangular diffuser. Reflectrols are to be supplied to assure uniform distribution of air to diffuser when the distance from the takeoff to the diffuser face is less than the recommended minimum by the manufacturer. Provide opposed blade type volume control dampers with each diffuser for fine tuning during air balancing. Throw from the center of the diffuser shall be adjusted to 75 percent of the distance between the diffuser and the wall or 35 percent of the distance between the two diffusers. Titus, Krueger, Carnes or equal.
 - 2. Ceiling Return and Exhaust Register: Removable, face, flush-mounted rectangular grille with round neck.
 - 3. Manufacturers: Titus, Krueger or Carnes or equal.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Install ductwork accessories in accordance with the manufacturer's printed instructions and approved Shop Drawings.

END OF SECTION

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

2.

A. Construction Drawings and general provisions of the contract, including general and supplementary conditions, and Division 1 specification sections, apply to this section.

1.2 SYSTEMS TO BE COMMISSIONED/TASKS:

- A. General: The systems to be commissioned shall include the following:
 - 1. Division 15 Systems
 - 2. Division 16 F/A system (Duct Detectors, Fire Smoke Dampers)
- B. Mechanical Systems: Provide functional performance testing for all modes of operation for all mechanical equipment included in the design. The "as applicable" caveat is intended to exclude any generically listed pieces of equipment that are not included in the design.
 - 1. Hydronic Flushing
 - a. Provide on-site attendance and witnessing of all flushing procedures by the mechanical contractor. Provide sufficient time for witnessing flushing procedures.
 - b. Assist and advise the contractor in completion of the flushing according to the specified and Owner required flushing procedures.
 - Air Conditioning Systems including:
 - a. Fans
 - b. VFD's
 - c. Dampers
 - d. Heating coils
 - e. Cooling coils
 - f. Room zone verification to verify correct sensor vs damper zoning.
 - g. Ventilation
 - 3. Terminal Units (as applicable) including:
 - a. VAV boxes and Reheat Coil units
 - b. Miscellaneous coils.
 - 4. Exhaust and Supply Systems including:
 - a. General
 - b. Toilet Exhaust
 - c. Kitchen Exhaust
 - 5. Facility Control System (Building Automation) including
 - a. Analog sensor calibration verification
 - b. Start/stop, status and alarm verification
 - c. Analog output scaling and device operation verification.
 - d. Sequence of operation testing for all modes of operation for all seasons including review of software.
 - e. Verification of MSIP graphics, point display, point command, alarming and BACnet interface database verification, interoperability performance.
 - f. Testing of the FCS shall occur in a timely manner to meet the construction schedule. If required, testing shall occur without the MSIP graphics to meet the construction schedule.
- C. Life Safety Systems:
 - 1. Fire Alarm System: Review test documentation; verify installation and operation of all

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required devices. Coordinate the verification walkthrough of the local Authority Having Jurisdiction. Observe initiation of each typical initiation device.

- 2. Duct Detectors: Test and certify the duct smoke detectors are installed and performing within the manufacturers requirements. Provide testing sheets for each detector. Provide all detector manufacturers performance data and verification that the location provides sufficient air velocities under all modes of operation to meet this data. In addition, verify the detector operation to verify appropriate shut down sequences.
- 3. Fire Smoke Dampers: Test and certify the fire/smoke dampers are installed and performing according to the design intent. Each damper shall be individually testing for proper close and open operation when the fire alarm system command requires this action.

1.3 WORK DESCRIPTION:

- A. General:
 - 1. Commissioning is a systematic process of providing documented confirmation that the tested building systems function in compliance with criteria set forth in the Project Documents to satisfy Building's operational needs. The commissioning process shall coordinate what have traditionally been separate functions of system documentation, equipment startup, control system calibration, testing and balancing, and performance testing.
 - 2. The Commissioning described herein, is not intended to supersede or replace the normal system startup by the contracting team, observations by the design team or balancing by the test and balance contractor.
 - 3. Commissioning Process: Due to the nature of school construction, all commissioning shall be performed concurrently with construction such that commissioning is approximately 95% complete prior to substantial completion acceptance and systems demo, and 100% complete prior to final acceptance. This is intended to:
 - a. Reduce as much as possible any duplication of work or testing for the Contractor.
 - b. Identify and solve any potential mechanical system design or construction problems as they relate to functional performance, prior to opening day.
- B. Commissioning Team:

1

- The commissioning team shall be made up of the:
 - a. Commissioning Authority
 - b. Representatives of the Owner,
 - c. Design Consultants
 - d. Construction Trades including major equipment suppliers.
- 2. The trades represented on the commissioning team will include:
 - a. Prime Contractor
 - b. Mechanical Contractor
 - c. Electrical Contractor
 - d. Building Management System Contractor
 - e. Fire Alarm System Contractor
 - f. Test, Adjust and Balancing Contractor
- 3. The lead tradesman for each trade who will actually perform or supervise the commissioning work is to be designated as the representative to the commissioning team.
- 4. Responsibility for various steps of the commissioning process will be divided among the members of the commissioning team, as described in this section.

1.4 DEFINITIONS:

- A. Definition of Terms:
 - 1. <u>Adjustment</u>: To change the speed, flow, position, signal, or level of any piece of

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mechanical equipment.

- 2. <u>Calibration</u>: To check or adjust the graduations of a quantitative measuring instrument against a known standard.
- 3. <u>Datalogging</u> monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers separate from the control system.
- 4. <u>Deficiency</u> a condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not comply with the design intent).
- 5. <u>Design Intent</u> a dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the owner. It is initially the outcome of the programming and conceptual design phases.
- 6. <u>Facility Control System (FCS)</u>: Other common acronyms are DDC (Direct Digital Controls), BAS (Building Automation System), BMS (Building Management System) or FMS (Facility Management System). This is the system providing automation functions for control of the HVAC and mechanical systems as well as alarming, monitoring, trending and interface/integration to related building systems such as fire alarm, security, card access, electrical switchgear, and stand-alone controls for major equipment such as chillers.
- 7. <u>Functional Performance Testing (FPT)</u>: This portion of the Commissioning Process involves dynamic tests that ensure that all mechanical systems function in accordance with design intent. The tests are dynamic and on-line and test the systems through all possible modes of operation.
- 8. <u>Installation Verification</u>: This initial portion of the Commissioning Process includes observations and punch-lists recorded and performed by the Engineer to ensure that all equipment is installed in accordance with the Specifications and Drawings. The Commissioning Authority shall overview this process.
- 9. <u>Minor Adjustment</u>: To add, subtract, or change various parameters included in the operation logic of a mechanical system or systems in order to improve or optimize operational performance. This refers only to the specified performance logic. Difficulties encountered in accomplishing a minor adjustment shall not be used to define a minor versus a major adjustment.
- 10. <u>Major Adjustment</u>: To fully change the specified operation logic of a mechanical system or systems. This refers only to the specified performance logic. Difficulties encountered in accomplishing a minor adjustment shall not be used to define a minor versus a major adjustment.
- 11. <u>Pre-functional checklists (PFC)</u>: This portion of the Commissioning Process involves primarily the test and balance and startup personnel to ensure that individual pieces of equipment are capable of performing in accordance with the Specifications, Drawings, and manufacturers' requirements. This is documented with a pre-functional checklist provided and completed by the contractor. The Commissioning Authority shall overview this testing.
- 12. <u>Statistical Sampling.</u> Functionally testing a statistically representative quantity (i.e. 15%) of identical or near identical pieces of equipment. Subject to 3% failure threshold whereby if there are greater than 3% testing failures of randomly chosen equipment, the testing shall be noted as failed and the Contractor shall re-verify the startup of 100% of the equipment. An additional identical statistically representative quantity of equipment shall again be tested which shall include a retest of 25% of the failed equipment and 75% randomly chosen untested equipment. This shall be repeated until the testing is noted as passing. Any proposed statistical sampling shall be identified in the construction phase commissioning plan and approved by the CxA.
- 13. <u>System Component or System Element</u>: A single piece of mechanical equipment such as a pump, fan, chiller, boiler, coil, etc. that when combined together through piping or ductwork will comprise a "System".
- 14. <u>System</u>: A combination of system components that allow the manufacture or distribution of conditioned air or water from one location to another.
- 15. <u>Tuning</u>: To adjust for maximum performance.

1.5 QUALIFICATIONS:

- A. The Commissioning Authority shall be contracted to an outside CxA. The process of commissioning as defined here-in goes well beyond typical HVAC system start-up both in detail of testing and in detail of documentation. The director of the commissioning process is the Commissioning Authority (CxA).
- B. Commissioning Authority Qualifications:
 - 1. The CxA shall have a documented experience specifically in building Commissioning.
 - 2. Documentable experience in Commissioning Central Utility Plants and projects of Similar size and scope.
 - 3. Document-able experience in startup and troubleshooting HVAC, hot water heating, fire suppression, electrical, emergency power, fire alarm, and life safety systems of similar complexity to those contained in these documents.
 - 4. A demonstrate-able working knowledge of complex environmental, fire alarm, electric power control and facility control systems; be capable of understanding control vendor's operating system and control code; be capable of troubleshooting control code and recommending necessary modifications.
 - 5. Provide resumes of individuals dedicated to project Commissioning.
 - 6. Competency in system design and intent.
 - 7. Knowledge of the test and balance of air and hydronic systems.
 - 8. Excellent communication and writing skills, organizational skills, and ability to work well with management and trades contractors.
 - 9. The Commissioning company shall not be directly or indirectly financially involved with any or the design or construction companies participating in the project.
 - 10. The CxA office shall be a full member of the Building Commissioning Association.
 - 11. The Commissioning personnel shall not be the project superintendent, foreman, safety officer, MEP coordinator or hold other duties that would keep him/her from fulfilling the responsibilities of Commissioning Authority.
- C. SUBMITTALS:
 - 1. Commissioning Plan Construction Phase: Within 30 calendar days of notice to proceed, submit a preliminary construction phase commissioning plan to identify how commissioning activities will be integrated into general construction and trade activities. The plan is the key means for the CxA to inform all parties as to how each system functions, independently and with respect to other systems. The plan shall be updated regularly and redistributed to the commissioning team for review and comment. The intent of this plan is to evoke questions, expose issues, and resolve them with input from the entire commissioning team early in construction. The commissioning plan shall identify how commissioning responsibilities are distributed. Include the following sections:
 - a. Executive Summary: Provide a description of the Commissioning Manual
 - b. Commissioning Team: Provide a listing of all commissioning team members including the names, addresses, and office/fax/cell phones number, commissioning authority, architect, mechanical engineer, electrical engineer, general contractor, mechanical contractor, electrical contractor, controls contractor, fire alarm system contractor and test & balance contractor.
 - c. System Overview: Provide a listing of design weather data, design parameters and all commissioned systems equipment data.
 - d. Overview of Testing Program Procedures: Provide a detailed description of the testing plan and procedures that will be implemented during the commissioning process.
 - e. Record Document Sequences of Operation: Provide a detailed sequence of operation that is utilized for testing purposes. The final commissioning report shall describe any modifications to the engineer specified sequences of operation.

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- f. Pre-Functional Testing Checklists: Provide prefunctional testing checklist forms to the contracting team for each individual piece of mechanical equipment. The forms shall describe all events required to fully start-up a piece of equipment.
- g. Functional Testing Procedures & Data Forms: Provide complete and detailed functional performance testing procedures required to fully test the entire system including the following:
 - 1) Identify which subcontractors will participate in each of the tests.
 - 2) Identify instrumentation required for each test.
 - 3) Identify who will provide instrumentation for each test.
 - 4) Operational description: This shall include, for example, the design criteria, design intent/basis of design, code requirements, specifics of the equipment to be provided, sequences of operation, operating priorities, protocols, etc. Some of these items will be provided to the CxA with the construction package and may be copied or referenced.
 - 5) Each procedure shall have a unique alphanumeric designator consisting of the applicable functional performance test procedure designator followed by a dash digit suffix to distinguish multiple repetitions of the same procedure.
 - 6) The same procedure may be applied to multiple identical pieces of equipment or systems.
 - 7) Procedures shall reference the applicable specification section upon which the procedure is based.
 - 8) Identify the value for all setpoints and inputs, positions of adjustable devices, valves, dampers, and switches.
 - 9) Identify the range of acceptable results for each condition tested.
 - 10) FPT procedures shall be detailed test instructions, written with sufficient step-by-step information to allow a test to be repeated under identical conditions with repeatable results.
 - 11) Include space to record: Description of the procedure; whether he form is for a retest of a failed procedure; identification and location of the equipment being tested; identification of instrumentation used by serial number; observed conditions at each step of the procedure; acceptable results as specified elsewhere; date of the test; names of technicians performing the procedure; name and signature of the CxA
- h. Provide samples of commissioning forms including:
 - Deficiencies and Issues Log: Provide a sample functional performance test deficiency report form. Include space to record: Associated functional performance test data form number; date of test; name of person reporting the deficiency; description of the observations associated with the failure of the test; cause of the failure, if apparent at the time of the test; date and description of corrective action taken; name and signature of person taking corrective action; and schedule for retest.
 - 2) Daily Log: Provide a blank log as an example.
 - 3) Meeting Minutes: Provide a blank log as an example.
- i. Commissioning schedule: Submit within 90 calendar days of notice to proceed.
- j. Test equipment identification list: For each instrument, sorted according to intended use: Manufacturer; model number; serial number; calibration certification; range; accuracy; resolution; and intended use.

1.6 COMMISSIONING RESPONSIBILITIES

- A. Commissioning Authority
 - 1. General Tasks:
 - a. Coordinate and manage the commissioning activities.
 - b. Schedule, agenda and attendees of commissioning process.

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- c. Coordinate directly with each Sub Contractor with respect to their responsibility and contractual obligations as it relates to commissioning.
- d. Obtain, assemble and submit commissioning documentation.
- e. Attend all on-site commissioning and construction activities.
- 2. Commissioning Documentation Development Tasks:
 - a. Develop the commissioning plan and schedule.
 - b. Incorporate detailed pre-functional check-off sheets and functional performance test procedures.
 - c. Coordinate locations of all required test ports required for testing and commissioning of the systems, and coordinate the installation verification inspections with the Engineer.
 - d. Prepare and submit the Commissioning Reports.
 - e. Assemble and submit the final Commissioning Report.
- 3. Pre-Functional Testing Tasks:
 - a. Be present during portions of the start-up activities and pre-functional testing to assist and witness the execution of startup.
 - b. Monitor the performance of the Test, Adjust and Balance contractor. Provide random sampling or direct witnessing of 20% of TAB contractor=s work.
- 4. Functional Performance Testing Tasks:
 - a. Direct the functional performance testing. Provide testing of all systems to provide complete confidence in the systems. The tests will include the interaction between individual components=, sub-systems and complete building systems under both normal and emergency power conditions.
 - b. Provide 100% functional performance testing on critical systems and statistical based functional performance testing on high quantity, less critical systems. Statistical based testing is a random testing of different components/systems and requires less than a 3% failure rate, or the entire system must be rechecked by the contractor. The breakdown is detailed on the list of included systems.
 - c. Enforce system compliance and recommend modifications to the system design that will correct or enhance the system performance.
 - d. Coordinate the owner witnessing of the tests.
 - e. Review the accuracy and calibration of any instrumentation utilized for the functional performance testing.
 - f. Track commissioning deficiencies until correction. Within each system, include one re-commissioning for any deficiencies. Additional re-commissioning time beyond scope of work will be tracked and reported to Architect.
- B. Design Engineer Responsibilities:
 - 1. The Design Engineer shall be responsible for the observations and checklists for the Installation Verification as defined in Part 2 of this specification.
 - 2. Additional calculation and investigation of design adjustments needs by the Engineers as defined by the Commissioning Authority.
 - 3. Participate in the resolution of potential design concerns as discovered during the commissioning process.
- C. Contractor Responsibilities:
 - 1. The Contractor shall be responsible for the Pre-functional Testing, a start-up procedure performed prior to balancing as defined in Part 2 of this specification.
 - 2. The Contractor shall be responsible for providing any technical personnel required for physical operation, testing, and simulation of control sequences for each piece of controlled equipment as required by the Commissioning Authority during the Functional Performance Testing. This shall include chiller service personnel, boiler service personnel, the temperature control engineering and technical startup crew, mechanical contracting service personnel for miscellaneous mechanical equipment, and balancing contractor personnel. To the extent possible, these personnel will be scheduled.

- 3. Additional calibration and adjustment of the mechanical equipment included in each mechanical system for proper operation under actual operation as defined by the Commissioning Authority.
- 4. Additional testing, calibration, adjustment, tuning, and minor adjustments to the temperature controls system sequences for proper operation under actual operation as defined by the Commissioning Authority.
- 5. Additional testing, calibration and adjustment of the mechanical water and airflows of each mechanical system for proper operation under actual operation as defined by the Commissioning Authority.

PART 2 - COMMISSIONING PROCESS

2.1 SCHEDULE:

- A. Commissioning schedule: Integrate functional performance testing and commissioning requirements into the master construction schedule. Commissioning scheduling is the responsibility of the Contractor.
 - 1. Prior to the beginning of start-up or functional performance testing activities, update the schedule of commissioning activities monthly.
 - 2. Two weeks prior to the beginning of start-up or functional performance testing activities, provide a detailed two-week look-ahead schedule. Thereafter, update the two-week look-ahead schedule weekly for the duration of commissioning for that construction phase. The two-week look-ahead schedule shall identify the date, time, beginning location, contractor personnel required, and anticipated duration for each startup or test activity.
- B. Commissioning of systems shall proceed per the criteria established in the specific sections that follow, with activities to be performed on a timely basis. Commissioning of systems may proceed prior to final completion of systems. The CxA must be available to respond promptly to avoid delay to the CPM schedule.
- C. Problems observed shall be addressed immediately, in terms of notification to responsible parties and actions to correct deficiencies.

2.2 COMMISSIONING MEETINGS

- A. Scope Meeting: Early in the construction process, a commissioning scoping meeting involving all members of the commissioning team shall be held at a time and place designated by Architect/Owner. The purpose of the meeting will be to familiarize all parties with the requirements of the commissioning process, and to ensure that the responsibilities of each party are clearly understood.
- B. Progress Meetings:
 - 1. Prior to the beginning of start-up or functional performance testing activities, the CxA will hold commissioning meetings biweekly. These meetings may be held concurrently with the general construction meetings.
 - 2. Beginning two weeks prior to the commencement of start-up or functional performance testing activities, whichever is earlier, the CxA will hold commissioning meetings at least weekly. Thereafter, and for the duration of commissioning for that construction phase, commissioning meetings will continue to be held at least weekly. These meetings may be held concurrently with the general construction meetings.
- C. The CxA may require additional meetings if the commissioning process appears to be behind schedule.

2.3 TEST EQUIPMENT

- A. The Division contractor for the equipment tested provides all standard or proprietary testing equipment required to perform startup and initial checkout and required functional performance testing. The mechanical contractor of Division 15 is ultimately responsible for all standard or proprietary testing equipment for the Facility Controls System (FCS) in Division 15, except for equipment specific to and used by TAB in their commissioning responsibilities. The Division contractor provides two-way radios.
- B. Include special or proprietary equipment, tools, software and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents in the base bid price to the Contractor and left on site, except for standalone data logging equipment used by the CxA.
- C. The CxA will provide data logging equipment and software required functionally to test equipment.
- D. Provide all testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Contract Documents. If not otherwise noted, the following minimum requirements apply:
 - 1. Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or 0.1°F.
 - 2. Pressure sensors shall have an accuracy of + or 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.
- E. Calibrate all equipment according to the manufacturer's recommended intervals and when dropped or damaged. Affix calibration tags or have certificates readily available.

2.4 SYSTEM START-UP AND TESTING

- A. General Requirements:
 - 1. All systems and system components shall be tested in presence of Commissioning Authority (and the Engineer if desired by the Engineer) to demonstrate compliance with specified requirements. To minimize the time of commissioning, contracting and engineering team members, testing shall be done in seasonal single blocks of time insofar as possible.
 - 2. The Contractor shall notify the Commissioning Authority fourteen (14) days prior to scheduled Functional Performance Tests, of the scheduled completion date of the Installation Verification and Pre-functional Testing.
 - 3. All testing shall be conducted under specified design operating conditions as approved by Commissioning Authority and Engineer.
 - 4. All elements of systems shall be tested to demonstrate that total systems satisfy all requirements of these Specifications. Testing shall be accomplished on hierarchical basis. Test each piece of equipment for proper operation, followed by each subsystem, followed by entire system, followed by any inter-ties to other major systems.
 - 5. All special testing materials and equipment shall be provided by Contractor. This includes, but is not limited to proprietary equipment hand-held control parameter/setpoint adjustment tools and water/air flow balancing readout and adjustment tools.
 - 6. Provide one copy of all test reports and records to Commissioning Authority.
- B. Test Procedure Development and Test Documentation:
 - 1. Within sixty (60) days prior to startup of the mechanical system, the Commissioning Authority shall prepare and submit to the Owners Representative and Engineer for review, descriptions of the test procedures which the Contractor will perform to demonstrate conformance of completed mechanical systems to the Plans and

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Specifications.

- 2. The decision of the Commissioning Authority and Engineer upon acceptability of test procedures shall be final. In the event of irresolvable conflict between decision of Commissioning Authority and Engineer, Engineer's decision shall have precedence. However, in no case shall such decision excuse the Contractor from fulfilling the requirements of commissioning as described in this Section.
- C. Installation Verification Recommendations:
 - 1. All systems and system components shall be checked and verified that they have been installed according to the drawings and specifications, and that all connections have been made correctly.
 - 2. Each system of interactive system components shall be observed and verified that it is ready to function as specified.
 - 3. Verification of complete and proper installation shall be completed prior to starting Component Performance Tests.
 - 4. The Installation Verification shall be documented in a checklist format for each system/piece of equipment. Each checklist shall be dated and initialed by the Engineer.
- D. Pre-functional Testing Requirements:
 - 1. Each system component shall be checked for proper installation, shall be adjusted, and shall be calibrated to verify that it is ready to perform as specified.
 - 2. All system components shall be checked to verify that they have been installed properly and that all connections have been made correctly. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence or other conditions which may cause damage.
 - 3. Verify that test, meter readings and specific electrical characteristics agree with those required by equipment or system manufacturer.
 - 4. All discrete elements and sub-systems of system components shall be adjusted and shall be checked for proper operation. Verify wiring and support components for equipment are complete and tested.
 - 5. Verification of complete and proper installation shall be completed prior to starting Functional Performance Tests.
 - 6. The Pre-functional Tests shall be documented in a checklist format for each system and each piece of equipment. Each checklist shall be dated and initialed by the Contractor.
- E. Functional Performance Testing Requirements:
 - 1. A Functional Performance Test shall be performed on each complete system. Each function shall be demonstrated to satisfaction of the Commissioning Authority on a paragraph-by-paragraph basis of the written test procedure, developed to demonstrate conformance to requirements of contract Specifications and the Design Intent Document.
 - 2. Each Functional Performance Test shall be witnessed and signed off by the Commissioning Authority and Contractor (and Owner=s Representative and Engineer if requested) upon satisfactory completion.
 - 3. The Functional Performance Testing Program shall be conducted in accordance with prior approved procedures and shall be documented as required hereinafter.
 - 4. The Commissioning Authority shall notify the owner, the contracting team, the architect, and the engineer at least two weeks prior to date of scheduled Functional Performance Tests. Schedule each of the seasonal Functional Performance Test periods over a single block of days. The schedule of the Functional Performance Tests shall be based on the construction completion schedule. Further communication to the owner, architect, or engineer concerning the Functional Performance Testing schedule and changes to that schedule due to construction delays or coordination conflicts shall not be required unless the noted parties have expressed an interest in writing in attending the testing.

2.5 COMMISSIONING REPORTS

A. Documentation - General:

- 1. The Commissioning Authority shall record and maintain detailed testing data. The data record shall be comprehensive and concise.
- 2. All data must be recorded as soon as possible during the course of the testing.
- 3. All documentation shall have the date, time, and names of persons participating in the inspection and testing.
- 4. All test instruments shall be documented for valid calibration.
- 5. The recording work sheets, inspection check lists, and performance testing plans must all be approved by the Engineer and Commissioning Authority prior to the start of Functional Performance Testing.
- B. Daily Commissioning Report Logs:
 - 1. The Commissioning Authority shall provide daily report logs to be included in the final report.
 - 2. The daily logs shall record the commissioning Authority personnel and event summaries of meetings, conversations, tests, failures, solutions, procedures and successes.
- C. Installation verification audit: Prior to start-up, the CxA shall maintain a report of installation verification audit activities. Identify equipment and components verified, deficiencies noted, corrective action taken, and the dates and initials of the persons making the entries.
- D. Start-up deficiency report: Within five days following start-up of each system or equipment, the CxA shall maintain start-up deficiency report forms. Identify systems and/or equipment started up, deficiencies noted, corrective action taken, and the dates and initials of the persons making the entries.
- E. Test, adjust and balance (TAB) progress reports: After TAB activities have begun, the TAB shall submit weekly TAB progress reports to the CxA. Identify:
 - 1. Systems or subsystems for which preliminary balancing is complete.
 - 2. Systems or subsystems for which final balancing is complete.
 - 3. Status of deficiencies and balancing problems encountered, including corrective actions taken.
 - 4. Updated schedule of remaining TAB activities.
- F. Deficiencies and Issues Report: At the end of each day, in which functional performance tests are conducted, the CxA shall maintain a deficiencies and Issues (D&I) log for tests for which acceptable results were not achieved during the day.
 - 1. Identify tests for which acceptable results were not obtained by test number and description, and equipment identification and location. Briefly describe observations about the performance that was associated with failure to achieve acceptable results. Identify the cause of failure if such is apparent.
 - 2. When corrections have been completed, the CxA shall update the functional performance test deficiency report forms. Identify corrective action taken and the dates and initials of the persons making the entries.
 - 3. Identify the schedule for re-testing.
- G. Final Commissioning Report: The CxA shall prepare and submit a final report with the closeout package. The binding format shall be 8 ½ x 11 bound documents with 11 x 17 fold out. This report shall contain:
 - 1. The report shall verify performance of commissioned equipment and systems.
 - 2. Document any field modifications to the testing process and why these modifications were made.
 - 3. The organization of the final commissioning report shall be as follows:

- a. Executive Summary of each mechanical system and problems encountered and resolved.
- b. System Overview summarizing the system design.
- c. Commissioning Plan
- d. Post Commissioned Controls Sequences and Points Lists.
- e. Prefunctional Testing Checklists
- f. Functional Testing Procedures and Results
- g. Deficiencies and Issues Logs
- h. Daily report logs.
- i. Appendix of letters, meeting minutes, memos and notes occurring during the commissioning process.
- H. Hardcopy and Electronic Versions:
 - 1. The Commissioning Plan provided prior to the on-site commissioning and the Final Commissioning Report provided at the conclusion shall be provided in hard copy (3 copies) and electronic on CD (3 copies).
 - 2. The Commissioning Plan CD shall include files developed in the most current MS Word format.
 - 3. The Final Commissioning Report CD shall contain scanned copies of all documentation developed and gathered during the Commissioning Process in Acrobat PDF format.

PART 3 - EXECUTION

3.1 GENERAL

A. The Functional Performance Testing portion of the commissioning process shall begin after the installation of the HVAC equipment and systems, along with related equipment, systems, structures, and areas are complete.

3.2 COMMISSIONING PROCEDURE

- A. Sequence of testing: Commissioning shall proceed from lower to higher levels of complexity. For each discrete subsystem or system, testing at the lower level shall be completed prior to starting the next higher level of tests. In general, the order of testing from lowest to highest is:
 - 1. Static tests (such as duct leakage tests).
 - Component functional performance tests (of motors, actuators, sensors, etc.) and startup.
 - 3. Balancing.
 - 4. System functional performance tests.
 - 5. Intersystem functional performance tests.
- B. Re-testing: The Contractor shall repeat, at no additional cost to Owner, the complete functional test procedure for each test for which acceptable results are not achieved. Repeat tests until acceptable results are achieved. The CxA shall track commissioning deficiencies until correction. Within each system, the CxA shall provide one re-commissioning for any deficiencies. For systems with large quantities of identical equipment, a statistical recommissioning strategy shall be applied to retest 30% of the deficiencies. The tested systems will not be witnessed by Architect until acceptable results are achieved, documented, reviewed and accepted.
- C. Correction of deficiencies:
 - 1. Correct functional performance test deficiencies promptly and schedule retest.
 - 2. Corrections during functional performance tests are generally prohibited to avoid consuming the time of personnel waiting for the test, but not involved in making the correction. Exceptions will be allowed if the cause of the failure is obvious and

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corrective action can be completed in less than five minutes. If corrections are made under this exception, the failure shall be noted on the functional performance test data form. A new functional performance test data form, marked "retest", shall be initiated after the correction has been made. The entire functional performance test procedure shall be repeated.

D. Delegated witnesses: Witnesses may be designated by Owner/Architect to observe the commissioning process. Witnesses shall provide no labor or materials in the commissioning process. The only function of the witnesses shall be to observe and comment on the progress and results of commissioning.

3.3 INSTALLATION VERIFICATION

- A. During construction, assist the Contractor and coordinate the AE's observation the work of the Contractor and subcontractors to ensure that all installations are being made in accordance with the intent of the contract documents.
- B. If any work is found to be incomplete, inaccessible, incorrect, or non-functional, make note of deficiencies and correct the deficiencies before system start-up work proceeds

3.4 PRE-FUNCTIONAL TESTING (SYSTEM START-UP)

- A. Assist the Contractor in the development a start-up plan and deficiency list. Commence with system start-up after approval has been given to the start-up plan and the pre-functional checklists have been signed off by the Contractor and subcontractors. The CxA and/or delegated representative shall witness system start-up and list all system and equipment deficiencies noted during start-up. The Contractor shall take corrective action on all system deficiencies noted and demonstrate suitable system operation to the CxA.
- B. Prepare start-up deficiency list forms to report deficiencies discovered in conjunction with system start-up. Start-up deficiency forms shall indicate the system being started up; the location and identification of the deficient equipment/material; date of observation; initials of the observer; observed deficiency; date of correction; initials of person making the correction; and corrective action taken.
- C. Issue start-up deficiency report forms to the Contractor for corrective action. The Contractor shall advise the CxA when all start-up deficiency list items have been corrected.

3.5 TEST, ADJUST, AND BALANCE (TAB)

- A. Assist the Contractor in the coordination the air and hydronic balancing. Advise the TAB firm when systems are complete and ready for balancing. Start TAB as early as possible following systems start-ups and component functional performance tests, in order to be essentially complete prior to system functional performance tests. Coordinate TAB activities with other construction schedule activities.
- B. Verify the accuracy of the TAB work prior to commencing any FPT activities that may be adversely affected by improper balancing.
- C. Spot check 10% of the TAB measured flows for all air and water flows. This may be accomplished by physically measuring those flows independently of the TAB or witnessing the TAB contractor's measurement of the required quantity.

3.6 FUNCTIONAL PERFORMANCE TEST PROCEDURES

A. The CxA shall develop as a part of the construction phase commissioning plan submittal, the

functional performance test (FPT) commissioning procedures and documentation to be used. Personnel experienced in the technical aspects of each system to be commissioned shall be enlarged if necessary to augment the expertise of the CxA. Include functional performance test procedures and functional performance test data sheets for each system based upon actual system configuration. Emphasis shall be placed on testing procedures that will conclusively determine actual system performance and compliance with the design.

- B. The test procedures shall fully describe system configuration and steps required for each test, appropriately documented so that another party can repeat the tests with virtually identical results.
- C. The FPT procedures must confirm the performance of systems to the extent of the design intent/basis of design and applicable code under which the project was permitted. When a system is accepted, Owner and Architect must be assured that the system is complete, works as intended, is correctly documented, and that the designated Owner staff is trained in the operation and maintenance of the system.
- D. The majority of mechanical equipment requires integral safety devices to stop/prevent equipment operation unless minimum safety standards or conditions are met. This could include adequate oil pressure, proof-of-flow, non-freezing conditions, maximum head pressure, etc. Functional performance test procedures shall demonstrate the actual performance of safety shutoffs in real or closely simulated conditions of failure.
- E. Systems may include safety devices and components that control a variety of equipment operating as a system. Interlocks may be hard-wired or installed via software. Functional performance test procedures shall demonstrate these interlocks.
- F. The CxA shall inform appropriate subcontractors and vendors before commissioning is started as to what the test and expected results will be. Whereas some test results and interpretations may not become evident until the actual tests are performed, all participants should have a reasonable understanding of the requirements. The commissioning plan must address the requirements and be distributed to all participants involved with that particular system.

3.7 REVIEW SOFTWARE DOCUMENTATION

A. The CxA shall review vendor/contractor/Owner-provided detailed FCS software documentation. This includes obtaining FCS program documentation, a review of the programming approach, interface with other systems (such as lighting, fire alarm, security, emergency generator monitoring, sump pumps, and utility metering), and a review of the specific software routines as applied to this project. Discrepancies in programming approaches shall be resolved to provide Owner with the most appropriate, simple, and straightforward approach to software routines.

END OF SECTION

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PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS:
 - A. Drawings and general provisions of the Contract, including Conformed General Conditions and Special Conditions, Division1, Division 15 and Division 16 Specification Sections, apply to this Section.
 - B. Section 15959 BAS COMMISSIONING
 - C. Section 15951 BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS
 - D. Section 15952 BAS OPERATOR INTERFACES
 - E. Section 15954 BAS COMMUNICATION DEVICES
 - F. Section 15953 BAS FIELD PANELS
 - G. Section 15955 BAS SOFTWARE AND PROGRAMMING
 - H. Section 15980 SEQUENCES OF OPERATION

1.2 DESCRIPTION OF WORK

- A. Provide a complete and operational system to perform all sequences of operations stated in the Sequence of Operation Section.
- B. The BAS currently utilizes electronic sensing, microprocessor-based digital control, and electronic actuation of dampers and valves to perform control sequences and functions. The BAS for this project shall consist of monitoring and control of systems listed below. Also reference the control drawings, the sequences of operation, and the points list.
- C. The systems to be controlled under work of this section basically comprise the existing HVAC systems in Level 2 and 3 (TI work), and new rooftop units for classrooms and accessory areas...
- D. BAS contractor shall obtain necessary information from client to verify existing controls point and maintain as-is operation in the entire building, for example some exhaust fan or split fan coil units may be on local controls only.

1.3 PROCUREMENT

- A. The BAS, DDC, and communications components installed as work of this contract, shall be an integrated distributed processing system by Honeywell Controls.
- 1.4 QUALITY ASSURANCE
 - A. Reserved
 - B. Installer's Qualifications: Firms specializing and experienced in control system installations for not less than 5 years. Firms with experience in DDC installation projects with point counts

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equal to this project and systems of the same character as this project. If installer is a Value Added Reseller (VAR) of a manufacturer's product, installer must demonstrate at least three years prior experience with that manufacturer's products. Sub-Contractors for installation of wiring, tubing, and conduit will not be allowed. Experience starts with awarded Final Completion of previous projects. Submittals must document this experience with references.

- C. Installer's Experience with Proposed Product Line: Firms shall have specialized in and be experienced with the installation of the proposed product line for not less than three years from date of final completion on at least 3 projects of similar size and complexity. Submittals shall document this experience with references.
- Installer's Field Coordinator and Sequence Programmer Qualifications: Individual(s) shall specialize in and be experienced with control system installation for not less than 5 years.
 Proposed field coordinator shall have experience with the installation of the proposed product line for not less than 2 projects of similar size and complexity.
- E. Installer's Service Qualifications: The installer must be experienced in control system operation, maintenance and service. Installer must document a minimum 5 year history of servicing installations of similar size and complexity. Installer must also document at least a one year history of servicing the proposed product line.

1.5 CODES AND STANDARDS

- A. The following codes and standards are intended to apply to the project or installation as applicable. All references to codes and standards herein refer to the latest edition at the time of contract execution.
- B. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - 1. 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings
 - 2. 62.1 Ventilation for Acceptable Indoor Air Quality
 - 3. ASHRAE 135: BACnet A Data Communication Protocol for Building Automation and Control Networks. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. current version including all annexes and addenda.
 - 4. 55 Thermal Environmental Conditions for Human Occupancy.
- C. Electronics Industries Alliance
 - 1. EIA-709.1-A-99: Control Network Protocol Specification
 - 2. EIA-709.3-99: Free-Topology Twisted-Pair Channel Specification
 - 3. EIA-232: Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
 - 4. EIA-458: Standard Optical Fiber Material Classes and Preferred Sizes
 - 5. EIA-485: Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.
 - 6. EIA-472: General and Sectional Specifications for Fiber Optic Cable
 - 7. EIA-475: Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications
 - 8. EIA-573: Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications
 - 9. EIA-590: Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications
 - 10. EIA-852: Tunneling of Component Network Data over IP Channels
- D. Underwriters Laboratories
 - 1. UL 916: Energy Management Systems.
- E. NEMA Compliance

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- 1. NEMA 250: Enclosure for Electrical Equipment
- 2. NEMA ICS 1: General Standards for Industrial Controls.
- F. NFPA Compliance
 - 1. NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
 - 2. NFPA 70 National Electrical Code (NEC)
- G. Institute of Electrical and Electronics Engineers (IEEE)
 - 1. IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems
 - 2. IEEE 802.3: CSMA/CD (Ethernet Based) LAN
 - 3. IEEE 802.4: Token Bus Working Group (ARCNET Based) LAN
 - 4. IEEE 519: Recommended Practices and Requirements for Harmonic Control in Electric Power Systems

1.6 DEFINITIONS

- A. Acknowledged: The data is broadcast repeatedly until an acknowledgement is received. This type of service should be used for critical data using one to one bindings only. This type of service shall not be used for one to many bindings.
- B. Adjustable (Adj): A characteristic of a control logic parameter such that it can be varied by the operator without downloading the program. See also initial value.
- C. Analog Calibration Offsets: For all analog input measured variables with the exception of velocity pressure, there is a requirement to adjust the value measured by the hardware based analog input point to match the value reported by a certified test instrument. An analog calibration offset is a parameter that can be added or subtracted from the raw value measured by the sensor to produce a calibrated value that will be use by the control logic and reported to the operator workstations. The initial value of this parameter is set at zero and it is adjusted when the calibration process is executed. This adjustment is referred to as a single point calibration. These parameters are mandatory for all analog inputs except velocity pressure sensors (requirements for velocity pressure sensors are presented elsewhere). These offset values are configuration parameters and as such shall be written to EEPROM. It shall be possible to change the value of these parameters from a graphic page.
- D. Advanced Application Controller (AAC): A device with limited resources relative to the Building Controller (BC). It may support a level of programming and may also be intended for application specific applications.
- E. Application Programming Tool: A vendor unique software tool used to create applications for programmable controllers.
- F. Application Protocol Data Unit (APDU): A unit of data specified in an application protocol and consisting of application protocol control information and possible application user data (ISO 9545).
- G. Application Specific Controller (ASC): A device with limited resources relative to the Advanced Application Controller (AAC). It may support a level of programming and may also be intended for application-specific applications.
- H. BACnet/BACnet Standard: BACnet communication requirements as defined by ASHRAE/ANSI 135 current version including all annexes and addenda.
- I. Bandwidth Utilization: The average utilization of the network capacity. Network loading is

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controlled by the use of event driven broadcast based data propagation and the use of appropriate binding services.

- J. Binding Services: When the network management tool within Niagara is used to establish a binding, the programmer selects one of three types of binding services:
 - 1. Unacknowledged: The data being broadcast is sent one time and an acknowledgement of receipt is not required. This type of service shall be used for non-critical data where there is no significant impact should the receiving device have to wait for the next broadcast.
 - 2. Unacknowledged Repeated: The data being broadcast is sent three times and an acknowledgement of receipt is not required. This type of service shall be used for most process control related data requiring timely receipt of the data.
 - 3. Acknowledged: The data is broadcast repeatedly until an acknowledgement is received. This type of service should be used for critical data using one to one bindings only. This type of service shall not be used for one to many bindings.
- K. Binding: The association of an output network variable from one device to the input network variable of a second device. There are three types of bindings:
 - 1. One to One: A single output network variable is bound to a single input network variable
 - 2. One to Many: A single output network variable is bound to input network variables on multiple devices.
 - 3. Many to One: Output network variables from multiple devices are bound to a single input network variable on a different device.
- L. Broadcasting: The propagation of data from a device to the control network. Software objects that broadcast data to the network shall include the following parameters:
- M. Building Automation System (BAS): The entire integrated energy management and control system
- N. Change of Value (COV): An event that occurs when a measured or calculated analog value changes by a predefined amount (ASHRAE/ANSI 135-1995).
- O. Client: A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device.
- P. Configuration Parameter: An input network variable to a controller (nci) that is written to the EEPROM. Configuration parameters can be changed periodically from the HMI but are not changed routinely as a function of control logic.
- Q. Continuous Monitoring: A sampling and recording of a variable based on time or change of state (e.g. trending an analog value, monitoring a binary change of state)
- R. Control System Server (CSS): A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device. As the BAS network devices are stand-alone, the CSS is not required for communications to occur.
- S. Controller or Control Unit (CU): Intelligent stand-alone control panel. Controller is a generic reference and is a PCU.
- T. Client's WAN: Reference to Clark County School District Information Technology network, used for normal business-related e-mail and Internet communication.
- U. Direct Digital Control (DDC): Microprocessor-based control including Analog/Digital conversion and program logic

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- V. Enumerated SNVT: Not Applicable.
- W. Error Rate: A measurement of communication quality that assesses the number of defective data packets as a percentage of the total number of data packets. Defective data packets are generally the result of poor installation practices or improper cable selection.
- X. Event Driven Communication: A term used to describe the propagation of data from a device to the network based on broadcasting rather than polling. The send on delta parameter is used to define the event and the data propagation is further controlled by the minimum and maximum send time parameters.
- Y. Free Topology: A data wiring topology that allows for loops, tees, y-connections etc. When this topology is used only one terminator of a specific design is required and allowable cable lengths are significantly reduced.
- Z. Functional Profile: A collection of variables required to define a the key parameters for a standard application. As this applies to the HVAC industry, this would include applications like VAV terminal, fan coil units, and the like.
- AA. Gateway (GTWY): A device, which contains two or more dissimilar networks/protocols, permitting information exchange between them (ASHRAE/ANSI 135-1995).
- BB. Hand Held Device (HHD): Manufacturer's microprocessor based device for direct connection to a Controller.
- CC. Host-Based Controller: Not Appliable.
- DD. JACE: Java Application Control Engine
- EE. Local Supervisory LAN Interface Device (LANID): Device used to facilitate communication and sharing of data throughout the BAS and client's WAN.
- FF. Media Access Control (MAC) hardware address that uniquely identifies each node of a network. Each different type of network medium requires a different MAC layer.
- GG. Managed Communication: Data transmission from a controller to a data manager, which rebroadcasts that data to a second controller. In some systems the data manager is referred to a Network Controller.
- HH. Manual Control: A concept where the operator from the operator workstation takes control of an end device and forces a specific position or state. From a software perspective, the value produced by the control logic is not allowed to affect the position or state of the end device. The manual mode and the desired manual position or states are parameters that are set by the operator.
- II. Many to One: Output network variables from multiple devices are bound to a single input network variable on a different device.
- JJ. Maximum Send Time Parameter: A parameter used to ensure the periodic update of network data. If a time period equal to the value of this parameter has expired without a broadcast of the variable, a re-broadcast of the current value shall be executed. See also send on delta and maximum send time parameter definitions.
- KK. Maximum Send Time: An adjustable parameter that defines the maximum time period between broadcasts of a software object's data to the network. Should the value of a software object remain constant over an extended period of time, the value will be rebroadcast once every

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maximum time period.

- LL. Minimum Send Time Parameter: A parameter used to control unnecessary broadcasting of data onto the network. A broadcast of an updated value shall not occur unless a time period equal to the value of this parameter has expired. The expiration of the time period does not mandate a re-broadcast. See also send on delta and maximum send time parameter definitions.
- MM. Minimum Send Time: An adjustable parameter that defines a mandatory time period during which no broadcasting of data will occur. Once this time period has been exceeded without a broadcast, the send on delta parameter or the maximum send time parameter shall determine when a broadcast is initiated.
- NN. MSIP: Multi-system Integration Platform
- OO. MSIP Interface Device: Device used to facilitate communication and sharing of data between the BAS at the school level and the client's EMS Department MSIP Web Supervisor via the client's WAN.
- PP. Multiple Controller Integrated Control (MCIC): A concept where multiple controllers with I/O are used to control a single mechanical system such as an air handling unit. Under this concept the mechanical system is sub-divided into a collection of processes to be controlled such as the fan start stop circuit, the fan variable speed drive, the mixed air section, the cooling coil section etc. With this concept all primary measured variables and the end device associated with a single process along with the primary control logic for the process shall be contained within a single controller. Secondary data from one process that affects the control of another process may be sent from one controller to the primary controller controlling the process. When data is sent from one controller to another controller, broadcasting concepts as defined above must be used. If the data being received over the network only affects the general thermodynamic or psychometric performance of the process but does not have a significant affect on safety or equipment protection then unacknowledged repeated binding services shall be used. If the data being received over the network does have a safety or equipment protection impact, then acknowledged repeated binding services shall be used. In both cases peer to peer communication is mandatory. All of the controllers must be on the same channel. Managed communication shall not be used to move data between the multiple controllers.
- QQ. One to Many: A single output network variable is bound to input network variables on multiple devices.
- RR. One to One: A single output network variable is bound to a single input network variable
- SS. Open Database Connectivity (ODBC): An open standard application-programming interface (API) for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system (DBMS) is handling the data.
- TT. Operator Interface (OI): A device used by the operator to manage the BAS including OWSs, and POTs,.
- UU. Operator Workstation (OWS): The user's interface with the BAS system via the internet or the Local Supervisory LAN. As the BAS network devices are stand-alone, the OWS is not required for communications to occur.
- VV. Peer to Peer Communication: Data is broadcast from its origin and is received by the final device requiring the data without being received and retransmitted by a third device.
- WW. Polling Communication: The process by which a control device requests a network variable

from a second control device at a specified interval. Polling communication is typically used to populate dynamic data on an active graphic page and for temporary or short term trending of data where the trend data is not stored at the controller level.

- XX. Portable Operators Terminal (POT): Laptop PC used both for direct connection to a controller and for remote dial up connection.
- YY. Primary Control Unit (PCU): A fully programmable device capable of carrying out a number of tasks including control and monitoring via direct digital control (DDC) of specific systems.
- ZZ. Repeater: A physical device used to connect two segments. A repeater does not filter any message traffic. A repeater does isolate physical problems such as short circuits to a single segment and is typically required to allow the use of additional devices or additional cable length.
- AAA. Router: A device that connects two or more networks at the network layer.
- BBB. Send on Delta Parameter: A parameter used to control unnecessary broadcasting of data onto the network. A broadcast of an output variable shall not occur unless the output variable has changed by an amount equal to or greater than the value of this parameter and the minimum send time has expired since the last broadcast. See also minimum send time and maximum send time parameter definitions. For binary data the send on delta parameter is assumed to be a change of state. Logic to support the send on delta concept may be imbedded in the configurable structure of an output point or programmed as part of the logic.
- CCC. Send on Delta: An adjustable parameter that defines a requirement to broadcast when the data generated by the software object changes by an amount that exceeds this parameter's value. For binary data, this parameter defaults to a change of state. The broadcast of data is initiated when this criteria and the minimum send time requirement have been met.
- DDD. Simple SNVT: A simple SNVT defines the format of a single piece of data. The definition of a simple SNVT in the master list of SNVTs will include the type of variable being measured (temperature, electric current, power etc.), the data type (signed integer, unsigned integer, floating point etc.), the data range, the resolution of the data and the engineering units.
- EEE. SQL: Standardized Query Language, a standardized means for requesting information from a database.
- FFF. Stand-Alone Controller: A stand alone controller has provisions for all of the physical inputs and physical outputs associated with a single mechanical component such as a terminal unit, air handling unit, chiller or boiler. The controller shall also have embedded in it all of the control logic that associated the physical inputs to the physical outputs. A stand-alone controller may rely on other networked devices for time schedule inputs and trend data storage.
- GGG. Structured SNVT: A structured SNVT defines the format of a network variable that contains several different data elements. A simple SNVT or an enumerated SNVT may define each data element within a structured SNVT.
- HHH. Supervisory Logic: The concept of gathering performance data from multiple terminal units to determine if a specific condition exists within the family of terminal devices. Examples: Are any of the VAV terminals supported by a particular AHU operating the reheat processes? Is there an indication from any of the control zones that an occupant has requested the temporary operation of the air delivery system?
- III. Terminator: An electronic component that consists of a resistive and capacitive circuit specifically designed to enhance the quality of communications on a segment. On a bus

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topology, a terminator is connected to each end of a segment. For a channel consisting of two bus topology segments, a total of 4 terminators are required, one at each end of each segment.

- JJJ. Test Mode: A concept where the operator from the operator work-station can interrupt the flow of data from a sensor to the control logic and insert a mandatory test value or test state to be used by the control logic. The test mode and the desired test value or states are parameters that are set by the operator.
- KKK. Unacknowledged Repeated: The data being broadcast is sent three times and an acknowledgement of receipt is not required. This type of service shall be used for most process control related data requiring timely receipt of the data.
- LLL. Unacknowledged: The data being broadcast is sent one time and an acknowledgement of receipt is not required. This type of service shall be used for non-critical data where there is no significant impact should the receiving device have to wait for the next broadcast.
- MMM. XIF File: Not Applicable.
- NNN. XML (Extensible Markup Language): A specification developed by the World Wide Web Consortium. XML is a pared-down version of SGML, designed especially for Web documents. It allows designers to create their own customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and between organizations.

1.7 FUNCTIONAL INTENT

A. Throughout Sections 15950 through 15980, the Sequences of Operation, and Section 15959, detailed requirements are specified, some of which indicate a means, method or configuration acceptable to meet that requirement. Contractor may submit products that utilize alternate means, methods, and configurations that meet the functional intent. However these will only be allowed with prior approval.

1.8 SUBMITTALS

- A. Submit under provisions of Div. 0. Refer to Section 15959 for additional commissioning submittal requirements.
- B. Electronic Submittals: While all requirements for hard copy submittal apply, control submittals and O&M information shall also be provided in electronic format as follows:
 - 1. Drawings and Diagrams: Shop drawings shall be provided on electronic media as an AutoCAD drawing (2002 version or later). All applicable 'cross-reference', font, and plot style files shall also be provided.
 - 2. Other Submittals: All other submittals shall be provided in Adobe PDF format.
 - 3. Media: Electronic submittals shall be included on a CD or DVD with each applicable submittal binder.
- C. Qualifications: Manufacturer, Installer, and Key personnel qualifications as indicated for the appropriate item above.
- D. Product Data: Submit manufacturer's technical product data for each control device, panel, and accessory furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes. Also include installation and start-up instructions.
- E. Shop Drawings: Submit shop drawings electronically in AutoCAD format (2002 version or later) for each control system, including a complete drawing for each air handling unit, system, pump, device, etc. with all point descriptors, addresses and point names indicated. Shop drawings shall contain the following information:

- 1. System Architecture and System Layout:
 - a. One-line diagram indicating schematic locations of all control units, workstations, LAN interface devices, and gateways. Indicate network number, device ID, address, device instance, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the diagram.
 - b. Floor plan drawings locating all control units, workstations, servers, LAN interface devices, and gateways. Include all WAN and LAN communication wiring routing, power wiring, power originating sources, and low voltage power wiring. Indicate network number, device ID, address, device instance, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the floor plans. Wiring routing as-built conditions shall be maintained accurately throughout the construction period and the drawing shall be updated to accurately reflect accurate, actual installed conditions.
- 2. Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices.
 - a. Include written description of sequence of operation; identify each major component (hardware and software) involved in the control scheme by its tag identifier. Show locations for all global measurement instruments for interior or exterior ambient conditions such as outside air temperature sensors, outside air humidity sensors, static pressure references, etc.
 - b. All physical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses identified as listed in the point summary table.
 - c. With each schematic, provide a point summary table listing building number and abbreviation, system type, equipment type, full point name, point description, Ethernet backbone network number, network number, device ID, object ID (object type, instance number). See Section 25 15 00 - Part III for additional requirements.
 - d. Label each control device with setting or adjustable range of control.
 - e. Label each input and output with the appropriate range.
 - f. Provide a Bill of Materials with each schematic. Indicate device identification to match schematic and actual field labeling, quantity, actual product ordering number, manufacturer, description, size, voltage range, pressure range, temperature range, etc. as applicable.
 - g. With each schematic, provide valve and actuator information including size, Cv, design flow, design pressure drop, manufacturer, model number, close off rating, etc. Indicate normal positions of spring return valves and dampers. This information shall also be summarized in comprehensive valve and damper schedules.
 - h. Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring that is existing, factory-installed, and portions to be field-installed.
 - i. Details of control panels, including controls, instruments, and labeling shown in plan or elevation indicating the installed locations.
- 3. Graphics: Provide color printouts of all specified graphic files including equipment schematics, tabular equipment data and floor plates.
- 4. All sheets in the submittal shall be consecutively numbered.
- 5. Each sheet shall have a title indicating the type of information included and the HVAC

system controlled.

- 6. Provide a Table of Contents listing sheet titles and sheet numbers
- 7. Legend and list of abbreviations
- F. As-Built Control Drawings: Provide and mount as-built shop drawings for all controlled systems and equipment. Drawings should be of sufficient size to be easily read. Locate as-built drawings as follows:
 - 1. During construction, drawings may be placed in plastic sleeves and mount in the control panel. The final drawings shall be laminated and permanently mounted in the control panel.
 - 2. For terminal units, print as-built drawings on adhesive-backed label and apply to controller enclosure or unit casing.
- G. Control Logic Documentation
 - 1. Submit control logic program listings (for graphical programming, if the requirements below are met) and logic flow charts illustrating (for line type programs) to document the control software of all control units.
 - 2. Control logic shall be annotated to describe how it accomplishes the sequence of operation. Graphic programs that provide simple blocks connected by multiple lines that are not specific in detail and easily understandable are not acceptable. Annotations shall be sufficient to allow an operator to relate each program component (block or line) to corresponding portions of the specified Sequence of Operation with all requirements of the sequence provided in detail. Provide in detail all virtual and real points, variables, PID loops, reset blocks, switches, timers, high/low selectors, alarms, proofing modules, staging blocks, etc. to fully describe the sequence of operation.
 - 3. Include written description of each control sequence.
 - 4. Include control response, settings, setpoints, throttling ranges, gains, reset schedules, adjustable parameters and limits.
 - 5. Sheets shall be consecutively numbered.
 - 6. Each sheet shall have a title indicating the controller designations and the HVAC system controlled.
 - 7. Include Table of Contents listing sheet titles and sheet numbers
 - 8. Submit one complete set of programming and operating manuals for all digital controllers concurrently with control logic documentation. This set will count toward the required number of Operation and Maintenance materials specified below and in Section 01 78 23.
 - 9. This portion of the submittal may be submitted after approval of all hardware, but shall be provided prior to installation of the network controller.
- H. Operation and Maintenance Materials:
 - 1. Submit documents under provisions of Div.1. In addition, an electronic version of the completed materials shall be provided on CD or DVD. Data can be in native file format or scanned where necessary.
 - 2. Submit maintenance instructions and spare parts lists for each type of control device, control unit, and accessory.
 - 3. Submit BAS User's Guides (Operating Manuals) for each controller type and for all workstation hardware and software and workstation peripherals.
 - 4. Submit BAS advanced Programming Manuals for each controller type and for all workstation software.
 - 5. Include all submittals (product data, shop drawings, control logic documentation, hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual; in accordance with requirements of Division 1.
- I. Controls contractor shall provide Owner with all product line technical manuals and technical bulletins, to include new and upgraded products, by the same distribution channel as to dealers

or branches. This service will be provided for 5 years as part of the contract price, and will be offered to Owner thereafter for the same price as to a dealer or branch.

- J. Manufacturers Certificates: For all listed and/or labeled products, provide certificate of conformance.
- K. Product Warranty Certificates: Submit manufacturers product warranty certificates covering the hardware provided.

1.9 PROJECT RECORD DOCUMENTS

- A. Submit documents under provisions of Division 1.
- B. Record copies of product data and control shop drawings updated to reflect the final installed condition.
- C. Record copies of approved control logic programming and database on paper and on CD's. Accurately record actual setpoints and settings of controls, final sequence of operation, including changes to programs made after submission and approval of shop drawings and including changes to programs made during specified testing.
- D. Record copies of approved project specific graphic software on CDs.
- E. Provide as-built network architecture drawings showing all nodes including a description field with specific controller identification, description and location information.
- F. Record copies shall include individual floor plans with controller locations with all interconnecting wiring routing including space sensors, LAN wiring, power wiring, low voltage power wiring. Indicate device instance, MAC address and drawing reference number.
- G. Provide record riser diagram showing the location of all controllers.
- H. Maintain project record documents throughout the warranty period and submit final documents at the end of the warranty period

1.10 SYSTEM ARCHITECTURE

- A. Integration:
 - 1. BAS shall be excel 5000 protocol, with database and communication integrated into the Multi-System Integration Platform (MSIP), through the client's WAN.
 - 2. All aspects of BAS software and programming shall be complete at the client's MSIP level, including sequences of operation, graphics, trending, and alarming, as defined specifically in Section 15955 & 15985, Section 15980, on the individual control drawings, and elsewhere in the contract documents.
 - 3. Any proprietary BAS programming software required in addition to the MSIP programming software shall reside on all OWS, POT, and CSS associated with the project. These interface devices shall facilitate direct communication with and programming of the BAS associated with the project and also provide for web-based access to the MSIP via the client's WAN.
- B. Application of Open Protocols: Subject to the detailed requirements provided throughout the specifications, the BAS and digital control and communications components installed, as work of this contract shall be an integrated distributed processing system utilizing Honeywell controls.
- C. The system provided shall incorporate hardware resources sufficient to meet the functional requirements of these Specifications. Contractor shall include all items not specifically itemized

in these Specifications that are necessary to implement, maintain, and operate the system in compliance with the functional intent of these Specifications.

- Interruptions or fault at any point on any Primary Controller LAN shall not interrupt communications between other nodes on the network. If a LAN is severed, two separate networks shall be formed and communications within each network shall continue uninterrupted. All line drivers, signal boosters, and signal conditioners etc. shall be provided as necessary for proper data communication.
 - Secondary Controller LAN ('Secondary LAN'): Network used to connect AACs, and ASCs. These can be Master Slave/ Token Passing or polling, in addition to those allowed for Primary Controller LANs. Network speed vs. the number of controllers on the LAN shall be dictated by the response time and trending requirements and other requirements of the specifications.
- E. Individual Controllers: The BCs, AACs, and ASCs shall monitor, control, and provide the field interface for all points specified. Each BC, AAC, or ASC shall be capable of performing all specified energy management functions, and all DDC functions, independent of other BCs, AACs, or ASCs and operator interface devices as more fully specified in Section 15953.

1.11 WARRANTY MAINTENANCE

- A. Contractor shall warrant all new products and labor for a period of 2 years after Final Acceptance.
- B. The Owner reserves the right to make changes to the BAS during the warranty period. Such changes do not constitute a waiver of warranty. Contractor shall warrant parts and installation work regardless of any such changes made by Owner, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS. Any disagreement between Owner and Contractor on such matters shall be subject to resolution through the contract 'Disputes' clause.
- C. At no cost to the Owner, during the warranty period, Contractor shall provide maintenance services for software, firmware and hardware components.
 - 1. Preventive maintenance shall be provided throughout the warranty period in accordance with the hardware component manufacturer's requirements.
 - 2. In the last month of the warranty period, all System software and controller firmware, software, drivers, etc. will be upgraded to the latest release (version) in effect at the end of the Warranty Period.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protect from weather.
- 1.13 LISTING AND LABELING
 - A. The BAS and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials shall be new, the best of their respective kinds without imperfections or blemishes, and shall not be damaged in any way. Used equipment shall not be used in any way for the permanent installation except where drawings or specifications specifically allow existing materials to remain in place.

2.2 UNIFORMITY

A. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF CONTROL SYSTEMS

- A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings, and details shown on drawings.
- B. Refer to additional requirements in other sections of this specification.

3.3 DIGITAL CONTROL STATIONS, CONTROLLER QUANTITY AND LOCATION

- A. Individual Digital Control Stations (DCS) are referenced to indicate allocation of points to each DCS and DCS location. Digital control stations shall consist of one or multiple controllers to meet requirements of this specification.
- B. Where a DCS is referenced, Contractor shall provide at least one (1) controller, and additional controllers as required, in sufficient quantity to meet the requirements of this Specification. Restrictions in applying controllers are specified in Section 15953 BAS Field Panels. This Contractor shall extend power to the DCS from an acceptable power panel. If the control contractor wishes to further distribute panels to other locations, control contractor is responsible for extending power to that location also. Furthermore, contractor is responsible for ensuring adequate locations for the panels that do not interfere with other requirements of the project and maintain adequate clearance for maintenance access.
- C. Contractor shall locate DCSs as referenced. It is the Contractor's responsibility to provide enough controllers to ensure a completely functioning system, according to the point list and sequence of operations.
- D. Contractor shall provide a minimum of the following:
 - 1. One DCS (including at least one controller) in each chilled water/hot water plant mechanical room
 - 2. One DCS (including at least one controller) for each air handler located in applicable mechanical room or on roof
 - 3. One DCS (including at least one controller) for each critical fan system
 - 4. One DCS (including at least one controller) for each pumping system
 - 5. One controller for each piece of terminal equipment located at the equipment.

3.4 SURGE PROTECTION

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A. Contractor shall furnish and install any power supply surge protection, filters, etc. as necessary for proper operation and protection of all BCs, AACs, ASCs, operator interfaces, printers, routers, gateways and other hardware and interface devices. All equipment shall be capable of handling voltage variations 10% above or below measured nominal value, with no affect on hardware, software, communications, and data storage.

3.5 CONTROL POWER SOURCE AND SUPPLY

- A. Section 15950 Contractor shall extend all power source wiring required for operation of all equipment and devices provided under Sections 15950 through 15980 and Sequences of Operation.
- B. General requirements for obtaining power include the following:
 - 1. In the case where additional power is required, obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 460V source, obtain power from the electrically most proximate 120v source fed from a common origin.
 - 2. Where a controller controls multiple systems on varying levels of power reliability (normal, emergency, and/or interruptible), the controller shall be powered by the highest level of reliability served. Furthermore, the controller in that condition shall monitor each power type served to determine so logic can assess whether a failure is due to a power loss and respond appropriately. A three-phase monitor into a digital input shall suffice as power monitoring.
 - 3. Standalone Functionality: Refer to Section 15953.

3.6 POWER MONITORING

- A. Not applicable, as-is operation.
- 3.7 BAS OPERATOR TRAINING and O&M Manuals
 - A. Provide up to 6 complete sets of the approved Operations and Maintenance (O&M) Manuals (hard copy and one electronic copy on CD in PDF format) to be used for training.
 - B. Contractor shall submit a Training Plan for the scope of training for which (s)he is responsible. Training Plan shall be forwarded to the Division 15 Contractor who will compile, organize, format, and forward to the Engineer for review. Once approved by the Engineer, training times shall be coordinated with the CLIENT'S Project Manager for CLIENT'S acceptance of the times and class outline.
 - C. Local Training: The local control contractor shall provide:
 - 1. One four (4) hour training courses for the designated CLIENT'S personnel to be performed at system demonstration.
 - 2. The class shall be taught by qualified personnel educated in the systems/products and adult learning techniques.
 - 3. Agenda: The course agenda shall include instruction on specific systems and instructions for operating the installed system. Topics covered shall include as a minimum:
 - a. HVAC System Overview
 - b. Operation of Control System
 - c. Function of each Component
 - d. System Operating Procedures
 - e. Programming Procedures
 - f. Maintenance Procedures

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D. Off-Site Advanced Training: Not applicable.

END OF SECTION

SECTION 15951

BAS MATERIALS, INTERFACE DEVICES, AND SENSORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Conformed General Conditions and Special Conditions, Division1, Division 15 and Division 16 Specification Sections, apply to this Section.
- B. Section 15950 BUILDING AUTOMATION SYSTEM (BAS) GENERAL
- C. Section 15959 BAS COMMISSIONING
- D. Section 15952 BAS OPERATOR INTERFACES
- E. Section 15954 BAS COMMUNICATION DEVICES
- F. Section 15953 BAS FIELD PANELS
- G. Section 15955 BAS SOFTWARE AND PROGRAMMING
- H. Section 15980 SEQUENCES OF OPERATION

1.2 DESCRIPTION OF WORK

- A. Refer to Section 15950 for general requirements.
- B. Refer to other Division 15 sections for installation of instrument wells, valve bodies, and dampers in electro-mechanical systems; not work of this section.
- C. Provide the following electrical work as work of this section, complying with requirements of Division 16 sections:
 - 1. Control wiring between field-installed controls, indicating devices, and unit control panels.
 - 2. Interlock wiring between electrically interlocked devices, sensors, and between a hand or auto position of motor starters as indicated for all mechanical and controls.
 - 3. Wiring associated with enunciator and alarm panels (remote alarm panels) and connections to their associated field devices.
 - 4. All other necessary wiring for fully complete and functional control system as specified.

1.3 WORK BY OTHERS

- A. Water Pressure Taps, Thermal Wells, Flow Switches, Flow Meters, etc. that will have wet surfaces, shall be installed under the applicable piping Section under the direction of Section 15951 Contractor who will be fully responsible for the proper installation and application.
- B. Power wiring for controlled equipment shall be furnished and installed under Division 16.
 Where 120 volt (V) control devices are used to control the equipment, Division 16 Contractor shall extend 120 V power wiring to the equipment. Section 15951 Contractor shall extend 120 V power wiring from the equipment to the control devices.

PART 2 - PART 2 - PRODUCTS

1.

2.1 MATERIALS AND EQUIPMENT

- A. General: Provide electronic and electric control products in sizes and capacities indicated, consisting of controllers, sensors, and other components as required for complete installation. Except as otherwise indicated, provide manufacturer's standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.
- B. Instrument Pipe and Tube
 - Hydronic and Instruments
 - a. Connection to Main Piping: Provide $\frac{1}{2}$ inch minimum size threadolet, $\frac{1}{2}$ " x 2 inch brass nipple, and $\frac{1}{2}$ " ball value for connection to welded steel piping. Provide tee fitting for other types of piping.
 - b. Remote Instruments: Adapt from ball valve to specified tubing and extend to remote instruments. Provide a union or otherwise removable fitting at ball valve so that connection to main can be cleaned with straight rod. Where manifolds with test ports are not provided for instrument, provide tees with ¼" FPT branch with plug for use as test port. Adapt from tubing size to instrument connection.
 - c. Line Mounted Instruments: Extend rigid piping from ball valve to instrument. Do not use close or running thread nipples. Adapt from ball valve outlet to instrument connection size. Provide a plugged tee if pipe makes 90 degree bend at outlet of valve to allow cleaning of connection to main with straight rod without removing instrument.
 - d. Instrument Tubing: Seamless copper tubing, Type K or L, ASTM B 88; with cast-bronze solder joint fittings, ANSI B1.18; or wrought-copper solder-joint fittings, ANSI B16.22; or brass compression-type fittings. Solder shall be 95/5 tin antimony, or other suitable lead free composition solder. Tubing OD size shall be not less than the larger of ¼" or the instrument connection size.
 - e. Rigid Piping For Line Mounted Instruments: Schedule 40 threaded brass, with threaded brass fittings.
 - 2. Low Pressure Air Instrument Sensing Lines
 - a. Connections: Use suitable bulkhead type fitting and static sensing tip for static pressure connections. Adapt tubing to instrument connection.
 - b. Indoor Tubing: Virgin polyethylene non-metallic tubing type FR, ASTM D 2737, with flame-retardant harness for multiple tubing. Use compression or push-on brass fittings.
 - c. Outdoor Tubing: Seamless copper tubing, Type K or L, ASTM B 88; with castbronze solder joint fittings, ANSI B1.18; or wrought-copper solder-joint fittings, ANSI B16.22; or brass compression-type fittings. Solder shall be 95/5 tin antimony, or other suitable lead free composition solder. Tubing OD size shall be not less than the larger of ¼" or the instrument connection size. Outdoor tubing shall be painted silver.
- C. Communication Wiring: All wiring shall be in accordance with the latest edition of the National Electrical Code and Division 16.
 - 1. Contractor shall supply all communication wiring between Building Controllers, Routers, Gateways, AAC's, ASC's and local and remote peripherals (e.g., operator workstations, printers, and modems).
 - 2. Local Supervisory LAN: For any portions of this network required under this section of the specification, Contractor shall use multimode fiber (62.5 micron) or Category 6E cable per TIA/EIA 68 (100BaseT). Network shall be run with no splices and separate from any wiring over thirty (30) volts.
 - 3. Primary and Secondary Controller LANs: Communication wiring shall be individually 100% shielded pairs per manufacturer's recommendations for distances installed, with

overall PVC cover, Class 2 run with no splices and separate from any wiring over thirty (30) volts. Refer to Division 26 for separation requirements. Shield shall be terminated and wiring shall be grounded as recommended by building controller manufacturer.

- D. Signal Wiring: Contractor shall run all signal wiring in accordance with the latest edition of the National Electrical Code and Division 16.
 - 1. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100% shielded pair, minimum 18-gauge wire (22-guage acceptable for smart space sensors), with PVC cover. Signal wiring shall be run with no splices and separate from any wiring above thirty (30) volts.
 - 2. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.
- E. Low Voltage Analog Output Wiring: Contractor shall run all low voltage control wiring in accordance with the latest edition of the National Electrical Code and Division 16.
 - 1. Low voltage control wiring shall be minimum 18-gauge, twisted pair, 100% shielded, with PVC cover, Class 2. Low voltage control wiring shall be run with no splices separate from any wiring above thirty (30) volts.
- F. Control Panels: Provide control panels with suitable brackets for wall mounting, unless noted otherwise, for each control system. Locate panel adjacent to systems served. Mount center of control panels 60" above finished floor in mechanical rooms or roof, or adjacent to unitary equipment installed outside mechanical rooms.
 - 1. General: All Controllers, Relays, Transducers, etc., required for stand-alone control shall be housed in a UL-rated, NEMA enclosure suitable for the installed conditions.
 - 2. Panels Inside the Building Envelope: Panels shall be constructed of 16-gage steel, totally enclosed on four sides, with removable perforated backplane, hinged door and coin latch, with manufacturer's standard shop- painted finish and color.
 - 3. Panels Outside the Building Envelope: Panels shall be constructed of 16-gage steel and have hinged door and lock hasp (owner will provide padlock). Provide hinged dead-front inside panel when flush-mounted control and/or indicating devices are included in panel. Panel interior shall be coupled to the cold deck of the RTU via a 2" conduit connection, the interior shall be internally lined with ½" rigid foam insulation, and a rainproof exhaust vent shall be provided.
 - 4. Control panel shall be completely factory wired and piped, and all electrical connections made to a terminal strip.
 - 5. All gauges and control components shall be identified by means of nameplates.
 - 6. All control tubing and wiring shall be run neatly and orderly fashion, providing 50% additional capacity, in open slot wiring duct with cover.
 - 7. Complete wiring and tubing termination drawings shall be mounted in, and a second set mounted adjacent to, each panel in a frame with lexan cover of sufficient size to be easily readable.

2.2 CONTROL VALVES

- A. General: Provide factory fabricated control valves of type, body material and pressure class indicated. All valves shall have valve position indication on the valve. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature in piping system. Provide valve size in accordance with scheduled or specified maximum pressure drop across control valve. Control valves shall be equipped with heavy-duty actuators, and with proper close-off rating for each individual application. Minimum close-off rating for any two-way valve/actuator combination shall be 110% of the total system (pump) head for water applications or 50 psig, whichever is greater.
- B. Globe Valves:

- 1. Valve Sizing: Where not specifically indicated in the contract documents, modulating valves shall be sized for maximum full flow pressure drop between 50% and 100% of the branch circuit it is controlling unless scheduled otherwise. Two-position valves shall be same size as connecting piping.
- 2. Single Seated (Two-way) Valves: Valves shall have equal-percentage characteristic for typical heat exchanger service and linear characteristic for building loop connections to campus systems unless otherwise scheduled on the drawings. Valves shall have cage-type trim, providing seating and guiding surfaces for plug on 'top-and-bottom' guided plugs.
- 3. Double Seated (Three-way) Valves: Valves shall have linear characteristic. Valves shall be balanced-plug type, with cage-type trim providing seating and guiding surfaces on 'top-and-bottom' guided plugs.
- 4. Temperature Rating: 25°F minimum, 250°F maximum.
- 5. Body: Bronze, screwed, 250 psi maximum working pressure for 1/2" to 2"; Cast iron, flanged, 125 psi maximum working pressure for 2-1/2" and larger.
- 6. Valve Trim: Bronze; Stem: Polished stainless steel.
- 7. Packing: Spring Loaded Teflon or Synthetic Elastomer U-cups, self-adjusting.
- 8. Plug: Brass, bronze or stainless steel, Seat: Brass.
- 9. Disc: Replaceable composition or stainless steel filled PTFE.
- 10. Ambient Operating Temperature Limits: -10 to 150°F (-12.2 to 66 °C).
- 11. Acceptable Manufacturers: Subject to compliance with requirements, approved manufacturers are as follows:
 - a. Belimo (2" and under)
 - b. Bray (2-1/2" and over)
 - c. Honeywell
 - d. Johnson
 - e. Siemens
- C. Butterfly Valves:
 - 1. Body: Extended neck epoxy coated cast or ductile iron with full lug pattern, ANSI Class 125 or 250 bolt pattern to match specified flanges.
 - 2. Seat: EPDM, except in loop bypass applications where seat shall be metal to metal.
 - 3. Disc: Bronze or stainless steel, pinned or mechanically locked to shaft.
 - 4. Bearings: Bronze or stainless steel.
 - 5. Shaft: 416 stainless steel.
 - 6. Cold Service Pressure: 175 psi.
 - 7. Close Off: Bubble-tight shutoff to 150 psi.
 - 8. Operation: Valve and actuator operation shall be smooth both seating and unseating. Should more that 2 psi deadband be required to seat/unseat the valve, valve shall be replaced at no cost to the Owner.
 - 9. Acceptable Manufacturers: Subject to compliance with requirements, approved manufacturers are as follows:
 - a. Belimo (2" and under)
 - b. Bray (2-1/2" and over)
 - c. Honeywell
 - d. Johnson
 - e. Siemens
- D. Ball Valves:
 - 1. Body:
 - a. <u>2" or less:</u> Valves shall utilize bronze bodies with female NPT threads. Valve bodies may also be stainless steel, titanium or nickel.
 - b. <u>2-1/2" or greater:</u> Valves shall have flanged carbon steel or stainless steel bodies rated at 300 psi working pressure.
 - 2. Seat: Reinforced teflon.
 - 3. Ball: Stainless steel.

- 4. Port: Segmented design with equal-percentage characteristic.
- 5. Cavitation Trim: Provide cavitation trim where indicated and/or required, designed to eliminate cavitation and noise while maintaining an equal percentage characteristic. Trim shall be a series of plates with orifices to break the pressure drop into multi-stages.
- 6. Stem: Stainless steel, blow-out proof design, extended to match thickness of insulation.
- 7. Cold Service Pressure: 200 psi WOG.
- 8. Acceptable Manufacturers: Subject to compliance with requirements, approved manufacturers are as follows:
 - a. Belimo (2" and under)
 - b. Bray (2-1/2" and over)
 - c. Honeywell
 - d. Johnson
 - e. Siemens

2.3 ACTUATORS

- A. General: Size actuators and linkages to operate their appropriate dampers or valves with sufficient reserve torque or force to provide smooth modulating action or 2-position action as specified. Select spring-return actuators with manual override to provide positive shut-off of devices as they are applied.
- B. Actuators
 - 1. Ambient Operating Temperature Limits: -10 to 150°F (-12.2 to 66 °C).
 - 2. Two Position Electric Actuators: Line voltage (120 volt, 24 volt) with spring return. Provide end switches as required.
 - a. Acceptable Manufacturers: Subject to compliance with requirements approved manufacturers are as follows:
 - 1) Siemens
 - 2) Bray
 - 3) Johnson
 - 4) Honeywell
 - 3. Electronic Actuators: Provide actuators with spring return for two-position (24v), 0-20VDC, 0-10VDC, or 4-20mA, as required. All modulating applications for primary HVAC equipment shall utilize true analog actuators. Simulated analog such as 3-point or pulse width modulation shall only be acceptable for VAV box terminal unit control.
 - a. Actuators shall travel full stroke in less than 90 seconds (VAV terminal box actuators may be up to 300 second full stroke time).
 - b. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed.
 - c. Actuators shall have positive positioning circuit, stroke indicator, current limiting motor protection, and manual position override.
 - d. Modulating actuators for valves shall have minimum rangeability of 40 to 1.
 - e. All actuator torque ratings shall be 150% of the requirements of the application. The minimum rating shall be 70 in-lbs for all actuators other than VAV box actuators. Provide a minimum of one actuator for each 25 square feet of damper area. For Multizone unit zones, provide 140 in-lbs for applications with four (4) or greater blades where one blade includes both hot and cold deck dampers
 - f. Close-Off Pressure: Provide the minimum torque required, and spring return for fail positioning sized for required close-off pressure. Required close-off rating for any two-way valve/actuator combination shall be 110% of the total system (pump) head for water applications or 50 psig, whichever is greater. Required close-off rating of air damper applications shall be shutoff pressure of associated fan, plus 10 percent.
 - g. Acceptable Manufacturers: Subject to compliance with requirements approved

manufacturers are as follows:

- 1) Siemens
- 2) Belimo
- 3) Honeywell
- C. Quarter-Turn Actuators (for ball valves):
 - 1. Electric
 - a. Motor: Suitable for 120 or 240 volt single-phase power supply. Insulation shall be NEMA Class F or better. Motor shall be rated for 100 percent duty cycle. Motors shall have inherent overload protection.
 - b. Gear Train: Motor output shall be directed to a self-locking gear drive mechanism. Gears shall be rated for torque input exceeding motor locked rotor torque.
 - c. Wiring: Power and control wiring shall be wired to a terminal strip in the actuator enclosure
 - d. Failsafe Positioning: Actuators shall be spring return type for failsafe positioning.
 - e. Enclosure: Actuator enclosure shall be a NEMA 4 epoxy coated metal enclosure, and shall have a minimum of two threaded conduit entries.
 - f. Limit Switches: Travel limit switches shall be UL approved. Switches shall limit actuator in both open and closed positions.
 - g. Mechanical Travel Stops: The actuator shall include mechanical travel stops of stainless steel construction to limit actuator to specific degrees of rotation.
 - h. Manual Override: Actuators shall have manual actuator override to allow operation of the valve when power is off. For valves 4 inches and smaller the override may be a removable wrench or lever or geared handwheel type. For larger valves, the override shall be a fixed geared handwheel type. An automatic power cut-off switch shall be provided to disconnect power from the motor when the handwheel is engaged for manual operation.
 - i. Valve Position Indicator: A valve position indicator with arrow and open and closed position marks shall be provided to indicate valve position.
 - j. Torque Limit Switches: Provide torque limit switches to interrupt motor power when torque limit is exceeded in either direction of rotation.
 - Position Controller: For valves used for modulating control, provide an electronic positioner capable of accepting 4-20 mA, 0-10 Vdc, 2-10 Vdc, and 135 Ohm potentiometer.
 - I. Ambient Conditions: Actuator shall be designed for operation from –140 to 150 °F ambient with 0 to 100 percent relative humidity.

2.4 GENERAL FIELD DEVICES

- A. Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers and as required for proper operation in the system.
- B. It shall be the Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.
- C. Field devices specified herein are generally 'two-wire' type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, is not designed to work with 'two-wire' type transmitters, if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the Contractor shall provide 'four-wire' type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as required.

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- D. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, Contractor shall furnish and install proper device, including 120V power as required. Such devices shall have accuracy and repeatability equal to, or better than, the accuracy and repeatability listed for respective field devices.
- E. Accuracy: As stated in this Section, accuracy shall include combined effects of nonlinearity, nonrepeatability and hysteresis.

2.5 TEMPERATURE SENSORS (TS)

- A. Sensor range: When matched with A/D converter of BC, AAC/ASC, or SD, sensor range shall provide a resolution of no worse than 0.5°F (unless noted otherwise).
- B. Room Temperature Sensor: To match existing/Honeywell standard installation for UNLV.
- C. Liquid Immersion Temperature Sensor: Shall consist of sensing element and connection head for wiring connections.
 - 1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.5°F accuracy at calibration point.
 - 2. Provide each sensor with brass or stainless steel thermowell of the appropriate length. Provide heat conductive compound between the well and sensor element.

2.6 HUMIDITY TRANSMITTERS

- A. Not applicable.
- 2.7 DIFFERENTIAL PRESSURE TRANSMITTERS (DP)
 - A. Not applicable.
- 2.8 VALVE BYPASS FOR DIFFERENTIAL PRESSURE SENSORS
 - A. Not applicable.
- 2.9 OUTDOOR AIR STATIC PRESSURE SENSING TIP
 - A. Not applicable.
- 2.10 AIRFLOW MEASURING STATIONS (AFMS)
 - A. Not applicable.
- 2.11 DIFFERENTIAL PRESSURE SWITCHES (DPS)
 - A. Not applicable.
- 2.12 PRESSURE SWITCHES (PS)
 - A. Diaphragm or bourdon tube with adjustable setpoint and differential and snap-acting Form C contacts rated for the application. Pressure switches shall be capable of withstanding 150% of rated pressure.

- B. Acceptable Manufacturers: Square D, ITT Neo-Dyn, ASCO, Penn, Honeywell, and Johnson Controls.
- 2.13 CURRENT SWITCHES (CS)
 - A. Clamp-On Design Current Operated Switch (for Constant Speed Motor Status Indication)
 - 1. Range: 1.5 to 150 amps.
 - 2. Trip Point: Adjustable.
 - 3. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
 - 4. Lower Frequency Limit: 6 Hz.
 - 5. Trip Indication: LED
 - 6. Approvals: UL, CSA
 - 7. Max. Cable Size: 350 MCM
 - 8. Acceptable Manufacturers: Veris Industries H-708/908; Inc., RE Technologies SCS1150A-LED.
 - B. Clamp-on Current Switch/Command Relay (CS/CR) (for Constant Speed Motors): Same as CS with 24v command relay rated at 5A @ 240 Vac resistive, 3A @ 240 Vac inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable Manufacturers shall be Veris Industries, Inc., Model # H938/735; or RE Technologies RCS 1150.
 - 1. Where used for single-phase devices, provide the CS/CR in a self-contained housing with override switch similar to Kele RIBX.
 - C. Clamp-On Design Current Operated Switch for Variable Speed Motor Status Indication
 - 1. Range: 1.5 to 135 Amps.
 - 2. Trip Point: Self-calibrating based on VA memory associated with frequency to detect loss of belt with subsequent increase of control output to 60 Hz.
 - 3. Switch: Solid state, normally open, 1 to 135 Vac or Vdc, 0.3 Amps. Zero off state leakage.
 - 4. Frequency Range: 5-75 Hz
 - 5. Trip Indication: LED
 - 6. Approvals: UL, CSA
 - 7. Max. Cable Size: 350 MCM
 - 8. Acceptable Manufacturers: Veris Industries, Inc. H-904.
 - D. Clamp-On Current Switch/Command Relay (CS/CR) (for Variable Speed Motors): Same as CS with 24v command relay rated at 5A @ 240 Vac resistive, 3A @ 240 Vac inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable manufacturer shall be Veris Industries, Inc., Model # H934. Substitutions shall be allowed per Division 1.
 - E. Variable Speed Status: Where current switches are used to sense the status for variable speed devices, the CT shall include on-board VA/Hz memory to allow distinction between a belt break and subsequent ramp up to 60 Hz, versus operation at low speed. The belt break scenario shall be indicated as a loss of status and the operation at low speed shall indicate normal status.
- 2.14 CURRENT TRANSFORMERS (CT)
 - A. Clamp-On Design Current Transformer (for Motor Current Sensing)
 - 1. Range: 1-10 amps minimum, 20-200 amps maximum.
 - 2. Trip Point: Adjustable.
 - 3. Output: 0-5 VDC.
 - 4. Accuracy: ±0.2% from 20 to 100 Hz.

5. Acceptable Manufacturers: KELE SA100.

2.15 POWER METER

A. Not applicable.

2.16 CONTINUOUS LEVEL TRANSMITTERS

- A. Capacitance Type
 - 1. General: Provide a loop powered, continuous capacitance type level transmitter with adjustable span and zero.
 - 2. Output: 4-20 mA.
 - 3. Probe: Fluoropolymer coated stainless steel rod or cable. Provide cable probe with end attachment hardware or weight.
 - 4. Electrical Enclosure: NEMA 4, 7.
 - 5. Approvals: UL or CSA.
 - 6. Accuracy: $\pm 1\%$ of calibrated span.
 - 7. Process Connection: MPT or ANSI Flange as required.
 - 8. Acceptable Manufacturers: Drexelbrook, Endress & Hauser.
- B. HYDROSTATIC PRESSURE
 - 1. General: Two wire smart d/p cell type transmitter.
 - 2. Output: 4-20 mA or 1 to 5 volt user selectable linear or square root output.
 - 3. Range: Adjustable span and zero.
 - 4. Probe: Stainless steel wetted parts.
 - 5. Environmental Limits: -40 to 250 °F (-40 to 121°C), 0 to 100% RH.
 - 6. Accuracy: Less than 0.1 percent of span.
 - 7. Output Damping: Time constant user selectable from 0 to 36 seconds.
 - 8. Vibration Effect: Less than $\pm 0.1\%$ of upper range limit from 15 to 2000 Hz in any axis relative to pipe mounted process conditions.
 - 9. Electrical Enclosure: NEMA 4, 4X, 7, 9.
 - 10. Approvals: FM, CSA.
 - 11. Acceptable Manufacturers: Rosemount Inc. 3051 Series, Foxboro, and Johnson-Yokagawa.

2.17 INSERTION TYPE TURBINE METER FOR WATER SERVICE

A. Not applicable.

2.18 ELECTRIC CONTROL COMPONENTS

- A. Manual Control Switches:
 - 1. Shall be UL listed for use in NEMA 1 enclosures with contact arrangement and rating suitable for the application
 - 2. Shall be bat handle or knob actuator with nameplate clearly identifying function of each switch position.
- B. Limit Switches (LS): Limit switches shall be UL listed, SPDT or DPDT type, with adjustable trim arm. Limit switches shall be as manufactured by Square D, Allen Bradley, or equal.
- C. Low Temperature Detector ('Freezestat') (FZ):
 - 1. Shall be DPDT (4-wire, 2-circuit) with automatic reset.
 - 2. Shall consist of a 'cold spot' element which responds only to the lowest temperature along any one foot of entire element, minimum bulb size of 1/8" x 20' (3.2mm x 6.1m).
 - 3. Temperature range 15 to 55°F (-9.4 to 12.8°C), factory set at 38°F.

- 4. Provide junction box for wiring connections and gasket to prevent air leakage or vibration.
- D. Thermostats:
 - 1. Not applicable.
- E. Aquastats: Shall be UL listed bi-metal insertion type, manual reset, with contact arrangement and rating as required by application and separable well for water service. Provide with set point limit stops as follows:
 - 1. Not applicable.
- F. Control Relays: All control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA 1 enclosure for indoor locations, NEMA 4 for outdoor locations.
 - 1. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:
 - a. AC coil pull-in voltage range of +10%, -15% or nominal voltage.
 - b. Coil sealed volt-amperes (VA) not greater than four (4) VA.
 - c. Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.
 - d. Pilot light indication of power-to-coil and coil retainer clips.
 - e. Coil rated for 50 and 60 Hz service.
 - f. Acceptable Manufacturers: Relays shall be Potter Brumfield, Model KRPA or approved equal.
 - 2. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load. Relays shall be IDEC or approved equal.
 - 3. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.
 - 4. All safety circuits shall be installed to operate individual interposing relays located in the associated equipment control panel. Each safety device (i.e. Freezestat, DP safety, smoke detector, etc.) wiring circuit shall be installed with individual homeruns back to the associated control panel.
- G. Control Transformers: Furnish and install control transformers as required. Control transformers shall be machine tool type, and shall be US and CSA listed. Primary and secondary sides shall have replaceable fuses in accordance with the NEC. Transformer shall be properly sized for application, and mounted in minimum NEMA 1 enclosure.
 - 1. Transformers shall be manufactured by Westinghouse, Square 'D', or Jefferson.
- H. Electric Push Button Switch: Switch shall be momentary contact, oil tight, push button, with number of N.O. and/or N.C. contacts as required. Contacts shall be snap-action type, and rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen Bradley or approved equal.
- I. Pilot Light: Panel-mounted pilot light shall be NEMA ICS 2 oil tight, transformer type, with screw terminals, push-to-test unit, LED type, rated for 120 VAC. Unit shall be 800T type, as manufactured by Allen-Bradley or approved equal.
- J. Alarm Horn: Panel-mounted audible alarm horn shall be continuous tone, 120 Vac Sonalert solid-state electronic signal, as manufactured by Mallory or approved equal.
- K. Electric Selector Switch (SS): Switch shall be maintained contact, NEMA ICS 2, oil-tight selector switch with contact arrangement, as required. Contacts shall be rated for minimum 120 Vac operation. Switch shall be 800T type, as manufactured by Allen-Bradley or approved equal.

2.19 REFRIGERANT MONITOR

A. Not Applicable.

2.20 IDENTIFICATION

- A. All control equipment shall be clearly identified by control shop drawing designation as follows:
 - 1. Other remote control devices metal tags or laser printed, adhesive backed, metalized polyester film labels.
 - 2. Control Panels engraved nameplate with panel number and system served
 - 3. Control Conduit Junction Boxes Painted medium blue with orange stripe.
 - 4. Number-code or color-code electrical conductors and pneumatic tubing, excluding those used for individual zone controls. Reflect this tagging or color-coding system on the Project Record Documents
 - 5. Controller Identification. All controllers shall be identified by a plastic engraved nameplate securely fastened to the outside of the controller enclosure with screws or rivets
 - 6. Panel Identification. All local control panels shall be identified by a plastic engraved nameplate securely fastened to the outside of the controller enclosure with screws or rivets
 - 7. Field Devices. All field devices shall be identified by a plastic engraved name plate attached with screws or rivets.
 - 8. Panel Devices. All panel devices shall be identified by a typed label securely fastened to the back plane of the local control panel

2.21 TESTING EQUIPMENT

A. Contractor shall test and calibrate all signaling circuits of all field devices to ascertain that required digital and accurate analog signals are transmitted, received, and displayed at system operator terminals, and make all repairs and recalibrations required to complete test. Contractor shall be responsible for test equipment required to perform these tests and calibrations. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (e.g., if field device is +/-0.5% accurate, test equipment shall be +/-0.25% accurate over same range).

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Owner.

3.2 INSTALLATION OF CONTROL SYSTEMS

- A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings. Install electrical components and use electrical products complying with requirements of the latest edition of the National Electrical Code and all local codes.
- B. Control Wiring: The term "control wiring" is defined to include providing of wire, conduit and miscellaneous materials as required for mounting and connection of electric control devices.
 1. Wiring System: Install complete wiring system for electric control systems. Conceal wiring except in mechanical rooms and areas where other conduit and piping are

exposed. Installation of wiring shall generally follow building lines. Install in accordance with the latest edition of the National Electrical Code and Division 16. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

- 2. Control Wiring Conductors: Install control wiring conductors, without splices between terminal points, color-coded. Install in neat workmanlike manner, securely fastened. Install in accordance with the latest edition of the National Electrical Code and Division 16.
- 3. Communication wiring, signal wiring and low voltage control wiring shall be installed separate from any wiring over thirty (30) volts. Signal wiring shield shall be grounded at controller end only, unless otherwise recommended by the controller manufacturer.
- 4. All WAN and LAN communication wiring shield shall be terminated as recommended by controller manufacturer. All WAN and LAN communication wiring shall be labeled with a network number, device ID at each termination and shall correspond with the WAN and LAN system architecture and floor plan submittals.
- 5. Install all control wiring external to panels in conduit. Installation of wiring shall generally follow building lines. Provide compression type connectors. Install wiring in galvanized rigid steel conduit at all exterior locations and where subjected to moisture or vandalism. Install in PVC Schedule 40 conduit if encased in concrete and below ground locations. All conduits penetrating partitions, walls or floors shall be sealed with a submitted and approved non-hardening putty material to prevent migration of air through the conduit system. There shall be no conduit run on the roof; all conduit run to rooftop equipment shall penetrate the plane of the roof inside the equipment curb.
- 6. All control conduits shall be identified by color code. Conduit shall be painted orange and blue at least every 10 feet, at all junctions, and at all wall penetrations.
- 7. Communication cabling shall be provided in an Owner approved color dedicated to the BAS.
- 8. Number-code or color-code conductors appropriately for future identification and servicing of control system. Code shall be as indicated on approved installation drawings.
- C. Outside Air Temperature/Humidity Sensors: An aspirated weatherproof and vandal proof enclosure shall be provided for outside air temperature and humidity sensors. These shall be mounted high on a north-facing exposure, clear from any undesirable influence (air intake, exhaust, heat source, etc.).
- D. Averaging Temperature Sensors: Cover no more than three square feet per linear foot of sensor. The sensor shall be installed according to manufacturer's recommendation and looped and fastened at a minimum of every 36 inches.
- E. Low Temperature Detector ('Freezestat') (FZ): Cover no more than one square foot per linear foot of sensor. The sensor shall be installed according to manufacturer's recommendation and looped and fastened at a minimum of every 36 inches.
- F. Fluid Flow Sensors: Install per manufacturer's recommendations in an unobstructed straight length of pipe.
- G. Relative Humidity Sensors:
 - 1. Provide element guard as recommended by manufacturer for duct probes in high velocity installations.
 - 2. Duct mounted sensors shall be mounted a minimum of 20 duct diameters downstream of any type of humidifiers or evaporative cooling equipment.
 - 3. Provide lockable metal guards for all sensors located in public areas.
- H. Water Differential Pressure Transmitters: Provide valve bypass arrangement to protect against over pressure damaging the transmitter.

- I. Flow Switches: Where possible, install in a straight run of pipe at least 15 diameters in length to minimize false indications. Install per manufacturers recommendations.
- J. Current Switches for Motor Status Monitoring: Adjust so that setpoint is below minimum operating current and above motor no load current.

END OF SECTION

BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS

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SECTION 15952

BAS OPERATOR INTERFACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Conformed General Conditions and Special Conditions, Division 1, Division 15 and Division 16 Specification Sections, apply to this Section.
- B. Section 15950 BUILDING AUTOMATION SYSTEM (BAS) GENERAL
- C. Section 15959 BAS COMMISSIONING
- D. Section 15951- BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS
- E. Section 15954 BAS COMMUNICATION DEVICES
- F. Section 15953 BAS FIELD PANELS
- G. Section 15955 BAS SOFTWARE AND PROGRAMMING
- H. Section 15980 SEQUENCES OF OPERATION

1.2 DESCRIPTION OF WORK

- A. Furnish and install all Operator Interfaces as required for the BAS functions specified.
- B. Refer to Section 15950 for general requirements.

PART 2 - PRODUCTS

- 2.1 MSIP WEB SUPERVISOR
 - A. A single Web Supervisor is used by UNLV to access its schools through one common interface (including programming) and as a single point for Master scheduling, trending, and alarming.
 - B. The Web Supervisor is existing.
 - C. The UNLV Environmental System Department MSIP Web Supervisor is existing and shall be reconfigured as necessary to facilitate integration of this project.

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Not Applicable.

END OF SECTION

BAS OPERATOR INTERFACES

SECTION 15953

BAS FIELD PANELS

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS:
 - A. Drawings and general provisions of the Contract including Conformed General Conditions and Special Conditions, Division1, Division 15 and Division 16 Specification Sections, apply to this Section.
 - B. Section 15950 BUILDING AUTOMATION SYSTEM (BAS) GENERAL
 - C. Section 15959 BAS COMMISSIONING
 - D. Section 15951- BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS
 - E. Section 15952 BAS OPERATOR INTERFACES
 - F. Section 15954 BAS COMMUNICATION DEVICES
 - G. Section 15955 BAS SOFTWARE AND PROGRAMMING
 - H. Section 15980 SEQUENCES OF OPERATION

1.2 PROCUREMENT

A. All new BAS, DDC, and communications components installed as work of this contract, shall be an integrated distributed processing system by Honeywell Controls.

1.3 DESCRIPTION OF WORK:

- A. Furnish and install new DDC Control units required to support specified BAS functions.
- B. Refer to Section 15950 for general requirements.

PART 2 - PRODUCTS

2.1 STAND-ALONE FUNCTIONALITY

- A. General: These requirements define stand-alone functionality relative to packaging I/O devices with a controller. Stand-alone functionality is specified with the controller and for each Application Category specified in Part 3. This item refers to acceptable paradigms for associating the points with the processor.
- B. Functional Boundary: Provide controllers so that all points associated with and common to one unit or other complete system/equipment shall reside within a single control unit. The boundaries of a standalone system shall be as dictated in the contract documents. Systems specified for the Application Category will dictate the boundary of the standalone control functionality (see related restrictions below). When referring to the controller as pertains to the standalone functionality, reference is specifically made to the processor. One processor shall execute all the related I/O control logic via one operating system that uses a common programming and configuration tool.

- C. The following configurations are considered acceptable with reference to a controller's standalone functionality:
 - 1. Points packaged as integral to the controller such that the point configuration is listed as an essential piece of information for ordering the controller (having a unique ordering number).
 - 2. Controllers with processors and modular back planes that allow plug in point modules as an integral part of the controller.
 - 3. I/O point expander boards, plugged directly into the main controller board to expand the point capacity of the controller.
 - 4. I/O point expansion devices connected to the main controller board via wiring and as such may be remote from the controller and that communicate via a sub LAN protocol. These arrangements to be considered standalone shall have a sub LAN that is dedicated to that controller and include no other controller devices. All wiring to interconnect the I/O expander board shall be:
 - a. Contained in the control panel enclosure;
 - b. Or run in conduit. Wiring shall only be accessible at the terminations.

2.2 BUILDING CONTROLLER (BC)

- A. General Requirements:
 - 1. The BC(s) shall provide fully distributed control independent of the operational status of the OWSs and CSS. All necessary calculations required to achieve control shall be executed within the BC independent of any other device. All control strategies performed by the BC(s) shall be both operator definable and modifiable through the Operator Interfaces.
 - 2. BCs shall perform overall system coordination, accept control programs, perform automated HVAC functions, control peripheral devices and perform all necessary mathematical and logical functions. BCs shall share information with the entire network of BCs and AACs/ASCs for full global control. Each controller shall permit multi-user operation from multiple workstations and portable operator terminals connected either locally or over the Primary Controller LAN. Each unit shall have its own internal RAM, non-volatile memory, microprocessor, battery backup, regulated power supply, power conditioning equipment, ports for connection of operating interface devices, and control enclosure. BCs shall be programmable from an operator workstation, portable operator terminal, or hand held operating device. BC shall contain sufficient memory for all specified global control strategies, user defined reports and trending, communication programs, and central alarming.
 - 3. BCs shall be connected to a controller network that qualifies as a Primary Controlling LAN.
 - 4. All BCs shall be protected from any memory loss due to a loss of power by one or a combination of the following:
 - a. Volatile RAM shall have a battery backup using a lithium battery with a rated service life of fifty (50) hours, and a rated shelf life of at least five years. Self-diagnostic routine shall report an alarm for a low battery condition.
 - b. EEPROM, EPROM, or NOVROM non-volatile memory
 - 5. In addition BCs shall provide intelligent, standalone control of HVAC functions. Each BC shall be capable of standalone direct digital operation utilizing its own processor, non-volatile memory, input/output, wiring terminal strips, A/D converters, real-time clock/calendar and voltage transient and lightning protection devices. Refer to standalone functionality specified above.
 - 6. The BC shall provide for point mix flexibility and expandability. This requirement may be met via either a family of expander boards, modular input/output configuration, or a combination thereof. Refer to stand alone functionality specified above.
 - 7. All BC point data, algorithms and application software shall be modifiable from the Operator Workstation.
 - 8. Each BC shall execute application programs, calculations, and commands via a microprocessor resident in the BC. The database and all application programs for each

BC shall be stored in non-volatile or battery backed volatile memory within the BC and will be able to upload/download to/from the OWS and/or CSS.

- 9. BC shall provide buffer for holding alarms, messages, trends etc.
- 10. Each BC shall include self-test diagnostics, which allow the BC to automatically alarm any malfunctions, or alarm conditions that exceed desired parameters as determined by programming input.
- 11. Each BC shall contain software to perform full DDC/PID control loops.
- 12. For systems requiring end-of-line resistors those resistors shall be located in the BC.
- 13. BC Input-Output Processing:
 - a. Multiplexing of IO Points Unacceptable: Each input and output shall be a discrete input or out put on the BC controller board. The use of supplementary input or output multiplexing boards, or any configuration that combines multiple inputs or outputs into a single point on the controller, is not acceptable.
 - b. Digital Outputs (DO): Outputs shall be rated for a minimum 24 Vac or Vdc, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output and a manual hand off or auto switch to allow for override. Provide feedback to remotely indicate the HOA is not in the Auto position. If these HOA switches are not provided on the main board they shall be provided via isolation relays within the control enclosure. Provide suppression to limit transients to acceptable levels.
 - c. Analog Inputs (AI): AI shall be 0-5 Vdc, 0-10 Vdc, 0-20 Vdc, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. A/D converters shall have a minimum resolution of 10 bits.
 - d. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board.
 - e. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
 - f. Electronic Analog Outputs (AO): Voltage mode: 0-5 Vdc and 0-10 Vdc; Current mode: 4-20 mA. Provide zero and span calibration and circuit protection.
 - Pulsed Inputs: Capable of counting up to 8 pulses per second with buffer to accumulate pulse count. Pulses shall be counted at all times.
- 14. A communication port for operator interface through a terminal shall be provided in each BC. It shall be possible to perform all program and database back-up, system monitoring, control functions, and BC diagnostics through this port. Standalone BC panels shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers, or workstations.
- 15. Each BC shall be equipped with loop tuning algorithm for precise proportional, integral, derivative (PID) control. Loop tuning tools provided with the Operator Workstation software is acceptable. In any case, tools to support loop tuning must be provided such that P, I, and D gains are automatically calculated.
- 16. All analog output points shall have a selectable failure setpoint. The BC shall be capable of maintaining this failure setpoint in the event of a system malfunction, which causes loss of BC control, or loss of output signal, as long as power is available at the BC. The failure setpoint shall be selectable on a per point basis.
- 17. Slope intercepts and gain adjustments shall be available on a per-point basis.
- 18. BC Power Loss:
 - a. Upon a loss of power to any BC, the other units on the primary controlling network shall not in any way be affected.
 - b. Upon a loss of power to any BC, the battery backup shall ensure that the energy management control software, the Direct Digital Control software, the database parameters, and all other programs and data stored in the RAM are retained for a minimum of fifty (50) hours. An alarm diagnostic message shall indicate that the BC is under battery power.
 - c. Upon restoration of power within the specified battery backup period, the BC shall resume full operation without operator intervention. The BC shall automatically reset its clock such that proper operation of any time dependent

function is possible without manual reset of the clock. All monitored functions shall be updated.

- d. Should the duration of a loss of power exceed the specified battery back-up period or BC panel memory be lost for any reason, the panel shall automatically report the condition (upon resumption of power) and be capable of receiving a download via the network, and connected computer. In addition, the Owner shall be able to upload the most current versions of all energy management control programs, Direct Digital Control programs, database parameters, and all other data and programs in the memory of each BC to the operator workstation via the local area network, or via the telephone line dial-up modem where applicable, or to the laptop PC via the local RS-232C port.
- 19. BC Failure:
 - a. Building Controller LAN Data Transmission Failure: BC shall continue to operate in stand-alone mode. BC shall store loss of communication alarm along with the time of the event. All control functions shall continue with the global values programmable to either last value or a specified value. Peer BCs shall recognize the loss, report alarm and reconfigure the LAN.
 - b. BC Hardware Failure: BC shall cease operation and terminate communication with other devices. All outputs shall go to their specified fail position.
- 20. Each BC shall be equipped with firmware resident self-diagnostics for sensors and be capable of assessing an open or shorted sensor circuit and taking an appropriate control action (close valve, damper, etc.).
- 21. BCs may include LAN communications interface functions for controlling secondary controlling LANs Refer to Section 25 14 00 BAS System Communications Devices for requirements if this function is packaged with the BC.
- 22. A minimum of four levels of password protection shall be provided at each BC.
- 23. BCs shall be mounted on equipment, in packaged equipment enclosures, or locking wall mounted in a NEMA 1 enclosure, as specified elsewhere.
- 24. In the last month of the warranty period, all controller firmware, software, drivers, etc. will be upgraded to the latest release (version) in effect at the end of the Warranty Period.
- B. BACnet Building Controller Requirements:
 - 1. The BC(s) shall support all BIBBs defined in the BACnet Building Controller (B-BC) device profile as defined in the BACnet standard.
 - 2. BCs shall communicate over the BACnet Building Controller LAN.
 - 3. Each BC shall be connected to the BACnet Building Controller LAN communicating to/from other BCs.
- 2.3 ADVANCED APPLICATION SPECIFIC CONTROLLER (AAC) AND APPLICATION SPECIFIC CONTROLLER (ASC)
 - A. General Requirements:
 - 1. AACs and ASCs shall provide intelligent, standalone control of HVAC equipment. Each unit shall have its own internal RAM, non-volatile memory and will continue to operate all local control functions in the event of a loss of communications on the ASC LAN or sub-LAN. Refer to standalone requirements by application specified in Part 3 of this section. In addition, it shall be able to share information with every other BC and AAC /ASC on the entire network.
 - 2. Each AAC and ASC shall include self-test diagnostics that allow the AAC /ASC to automatically relay to the BC, LAN Interface Device or workstation, any malfunctions or abnormal conditions within the AAC /ASC or alarm conditions of inputs that exceed desired parameters as determined by programming input.
 - 3. AACs and ASCs shall include sufficient memory to perform the specific control functions required for its application and to communicate with other devices.
 - 4. Each AAC and ASC must be capable of stand-alone direct digital operation utilizing its own processor, non-volatile memory, input/output, minimum 8 bit A to D conversion,

voltage transient and lightning protection devices. All volatile memory shall have a battery backup of at least fifty- (50) hrs with a battery life of five years.

- 5. All point data, algorithms and application software within an AAC /ASC shall be modifiable from the Operator Workstation.
- 6. In the last month of the warranty period, all controller firmware, software, drivers, etc. will be upgraded to the latest release (version) in effect at the end of the Warranty Period.
- 7. AAC and ASC Input-Output Processing
 - a. Multiplexing of IO Points Unacceptable: Each input and output shall be a discrete input or out put on the AAC/ASC board. The use of supplementary input or output multiplexing boards, or any configuration that combines multiple inputs or outputs into a single point on the controller, is not acceptable.
 - b. Digital Outputs (DO): Outputs shall be rated for a minimum 24 Vac or Vdc, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each output shall have an LED to indicate the operating mode of the output and a manual hand off or auto switch to allow for override. Provide feedback to remotely indicate the HOA is not in the Auto position. If these HOA switches are not provided on the main board they shall be provided via isolation relays within the control enclosure. Provide suppression to limit transients to acceptable levels.
 - c. Analog Inputs (AI): AI shall be 0-5 Vdc, 0-10 Vdc, 0-20 Vdc, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. A/D converters shall have a minimum resolution of 10 bits.
 - d. Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the AAC/ASC and shall be isolated from the main board.
 - e. Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
 - f. Electronic Analog Outputs (AO): Voltage mode: 0-5 Vdc and 0-10 Vdc; Current mode: 4-20 mA. Provide zero and span calibration and circuit protection.
 - g. Pulsed Inputs: Capable of counting up to 8 pulses per second with buffer to accumulate pulse count. Pulses shall be counted at all times.
- B. BACnet AAC(s) and ASC(s) Requirements:
 - 1. The AAC(s) and ASC(s) shall support all BIBBs defined in the BACnet Building Controller (B-AAC and B-ASC) device profile as defined in the BACnet standard.
 - 2. AAC(s) and ASC(s) shall communicate over the BACnet Building Controller LAN or the ASC LAN or sub-LAN.
 - 3. Each BC shall be connected to the BACnet Building Controller LAN communicating to/from other BCs.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
- 3.2 INSTALLATION OF CONTROL SYSTEMS
 - A. General: Install systems and materials in accordance with manufacturer's instructions, specifications roughing-in drawings and details shown on drawings. Contractor shall install all controllers in accordance with manufacturer's installation procedures and practices
 - B. Mounting: All controllers shall be mounted within control panels as defined in Section 15951.

3.3 HARDWARE APPLICATION REQUIREMENTS

- A. General: The functional intent of this specification is to allow cost effective application of manufacturers standard products while maintain the integrity and reliability of the control functions. A BC as specified above is generally fully featured and customizable whereas the AAC/ASC refers to a more cost-effective unit designed for lower-end applications. Specific requirements indicated below are required for the respective application. Manufacturer may apply the most cost-effective unit that meets the requirement of that application.
- B. Standalone Capability: Each Control Unit shall be capable of performing the required sequence of operation for the associated equipment. All physical point data and calculated values required to accomplish the sequence of operation shall originate within the associated CU with only the exceptions enumerated below. Refer to Item 2.01 above for physical limitations of standalone functionality. Listed below are functional point data and calculated values that shall be allowed to be obtained from or stored by other CUs via LAN.
- C. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.
- D. Application Category 0

1.

1.

- Applications in this category include the following:
 - a. Monitoring of variables that are not used in a control loop, sequence logic, or safety.
- 2. Points on BCs, AACs, and ASCs may be used in these applications as well as generalpurpose I/O modules.
- 3. Where these points are trended, contractor shall verify and document that the network bandwidth is acceptable for such trends and is still capable of acceptable and timely control function.
- E. Application Category 1
 - Applications in this category include the following:
 - a. Airflow Control Boxes (Constant Volume Terminal Units)
 - b. Misc. Heaters
 - c. Unitary equipment <15 tons (Package Terminal AC Units, , Split-System AC Units, water source heat pumps)
 - 2. ASCs may be used in these applications.
 - 3. Standalone Capability: Provide capability to execute control functions for the application for a given setpoint or mode, which shall generally be occupied mode control. Only the following data (as applicable) may be acquired from other controllers via LANs. In the event of a loss of communications with any other controller, or any fault in any system hardware that interrupts the acquisition of any of these values, the ASC shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

Physical/Virtual Point	<u>Default</u> <u>Value</u>
Scheduling Period	Occupied
Morning Warm-Up	Off (cold discharge air)
Summer/Winter	Winter
Trend Data	N/A

- 4. LAN Restrictions: For networks operating at 38.4 kbps or less, limit the number of nodes on the network to meet all system performance criteria and to no more than 80% of the maximum recommended by the manufacturer. For networks operating at greater than 38.4 kbps limit the number of nodes on the network to meet all system performance criteria up to the maximum recommended by the manufacturer.
- F. Application Category 2
 - 1. Applications in this category include the following:
 - a. Unitary Equipment >= 15 tons (Air Conditioners, Heat Pumps, Packaged Heating/Cooling Units, and the like)
 - b. Small, Constant Volume Single Zone Air Handling Units
 - c. Constant Volume Pump Start/Stop
 - d. Misc. Equipment (Exhaust Fan) Start/Stop
 - e. Misc. Monitoring (not directly associated with a control sequence and where trending is not critical)
 - 2. BCs may be used in these applications.
 - 3. ASC's may be used in these applications provided the ASC meets all requirements specified below. This category requires a general-purpose ASC to which application-specific control algorithms can be attached.
 - 4. Standalone Capability: Only the following data (as applicable) may be acquired from other AACs/ASCs via LANs. In the event of a loss of communications with any other ASCs, or any fault in any system hardware that interrupts the acquisition of any of these values, the AAC/ASC shall use the last value obtained before the fault occurred. If such fault has not been corrected after the specified default delay time, specified default value(s) shall then be substituted until such fault has been corrected.

Physical/Virtual Point	<u>Default Delay Time</u>	<u>Default</u> Value
Outside Air Temperature	5 minutes	80°F
Outside Air Humidity	5 minutes	60%RH
Outside Air Enthalpy	5 minutes	30 Btu/lb
Trend Data	N/A	
Cooling/Heating Requests	5 minutes	None

5. LAN Restrictions: Limit the number of nodes servicing any one of these applications on the AAC/ASC LAN to 32.

G. Application Category 3

- 1. Applications in this category include the following, but does not apply to this project (N.I.C.):
 - a. Large Constant Volume Air Handlers
 - b. Multizone Air Handlers, including individual zones
 - c. Air Handlers serving critical areas
 - d. Central Cooling Plant
 - e. Central Heating Plant
 - f. Cooling Towers
 - g. Sequenced or Variable Speed Pump Control
 - h. Local Chiller Control (unit specific)
- 2. BCs shall be used in these applications.
- 3. LAN Restrictions: Comply with 2.01, Stand-Alone Functionality, above.

- H. CONTROL UNIT REQUIREMENTS
 - 1. Refer to Section 15950 for requirements pertaining to control unit quantity and location.

END OF SECTION

SECTION 15954

BAS COMMUNICATION DEVICES

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS:
 - A. Drawings and general provisions of the Contract, including Conformed General Conditions and Special Conditions, Division1, Division 15 and Division 16 Specification Sections, apply to this Section.
 - B. Section 15950 BUILDING AUTOMATION SYSTEM (BAS) GENERAL
 - C. Section 15959 BAS COMMISSIONING
 - D. Section 15951- BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS
 - E. Section 15952 BAS OPERATOR INTERFACES
 - F. Section 15953 BAS FIELD PANELS
 - G. Section 15955 BAS SOFTWARE AND PROGRAMMING
 - H. Section 15980 SEQUENCES OF OPERATION

1.2 DESCRIPTION OF WORK

- A. Contractor shall provide all interface devices and software to provide an integrated system connecting BCs, AACs, ASCs and Gateways to the Owner's Wide Area Network (CLIENT'S WAN).
- B. The intent of all specified interface to packaged controls is that the interface be provided by this section, even if specific terminations for remote inputs or outputs are not provided by the packaged equipment controls. This shall be provided by adding interposing relays, paralleling analog signals or biasing setpoints. The specific means of interface shall be coordinated between the BAS contractor and the packaged equipment vendor. If specific terminations for remote monitoring or control are provided, these shall be utilized.
- C. It is not the intent for this section to provide major components for the packaged controls that do not exist (other than the interface methods listed above). However, the BAS hardware, software, conduit and wire shall be installed for future connection to the interface. For example, if setpoint reset card for a chiller has not been provided with the chiller package, it is not the intent for this section to provide such card.

PART 2 - PRODUCTS

- 2.1 NETWORK CONNECTION
 - A. Not applicable, existing.
- 2.2 MULTIPLE SYSTEM INTEGRATION PLATFORM INTERFACE DEVICE (MSIPID)

A. Not applicable, existing.

2.3 LOCAL SUPERVISORY LAN INTERFACE DEVICE (LANID)

- A. Not applicable, existing.
- 2.4 VFD Interface Device (VFDID)
 - A. The VFDID shall be a microprocessor-based communications device that acts as a gateway between the BAS protocol and the applicable VFD controller.
 - B. The VFDID shall contain its own microprocessor, RAM, battery, communication ports and, power supply.
 - C. Each VFDID shall support full bi-directional communication.
 - D. Communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, acceleration/deceleration time adjustments, and lock and unlock the keypad. The drive shall allow the BAS to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The BAS shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus; keypad "Hand" or "Auto" selected, bypass selected, the ability to change the PID setpoint, and the ability to force the unit to bypass (if bypass is specified). The BAS system shall also be able to monitor if the motor is running in the VFD mode or bypass mode (if bypass is specified) over the communications interface. A minimum of 15 field parameters shall be capable of being monitored.
 - E. The VFD shall allow the BAS to control the drive's digital and analog outputs via the serial interface. This control shall be independent of any VFD function. For example, the analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive's digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive's digital and analog inputs shall be capable of being monitored by the BAS system.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF CONTROL SYSTEMS

- A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.
- B. Contractor shall provide all interface devices and software to provide an integrated system.

END OF SECTION

SECTION 15955

BAS SOFTWARE AND PROGRAMMING

PART 1 - GENERAL

- 1.1 RELATED DOCUMENTS:
 - A. Drawings and general provisions of the Contract, including Conformed General Conditions and Special Conditions, Division1, Division 15 and Division 16 Specification Sections, apply to this Section.
 - B. Section 15950 BUILDING AUTOMATION SYSTEM (BAS) GENERAL
 - C. Section 15959 BAS COMMISSIONING
 - D. Section 15951 BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS
 - E. Section 15952 BAS OPERATOR INTERFACES
 - F. Section 15953 BAS FIELD PANELS
 - G. Section 15954 BAS COMMUNICATION DEVICES
 - H. Section 15980 SEQUENCES OF OPERATION

1.2 DESCRIPTION OF WORK:

A. Control software, its licensing and devices are existing and shall be reused and utilized to perform complete sequence as stated in these documents.

PART 2 - PRODUCTS

- 2.1 SYSTEM SOFTWARE-GENERAL
 - A. Functionality and Completeness: Contractor shall furnish and install all software and programming necessary to provide a complete and functioning system as specified. Contractor shall include all software and programming not specifically itemized in these Specifications, which is necessary to implement, maintain, operate, and diagnose the system in compliance with these Specifications.
 - B. Configuration: The software shall support the system as a distributed processing network configuration.

2.2 CONTROLLER SOFTWARE

- A. BC Software Residency: Each BC as defined below shall be capable of control and monitoring of all points physically connected to it. All software including the following shall reside and execute at the BC:
 - 1. Real-Time Operating System software
 - 2. Real-Time Clock/Calendar and network time synchronization
 - 3. BC diagnostic software
 - 4. LAN Communication software/firmware

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BAS SOFTWARE AND PROGRAMMING

- 5. Direct Digital Control software
- 6. Alarm Processing and Buffering software
- 7. Energy Management software
- 8. Data Trending, Reporting, and Buffering software
- 9. I/O (physical and virtual) database
- 10. Remote Communication software
- B. AAC/ASC Software Residency: Each AAC/ASC as defined below shall be capable of control and monitoring of all points physically connected to it. As a minimum, software including the following shall reside and execute at the AAC/ASC. Other software to support other required functions of the AAC/ASC may reside at the BC or LAN interface device (specified in Section 15954) with the restrictions/exceptions per application provided in Section 15953 :
 - 1. Real-Time Operating System software
 - 2. AAC/ASC diagnostic software
 - 3. LAN Communication software
 - 4. Control software applicable to the unit it serves that will support a single mode of operation
 - 5. I/O (physical and virtual) database to support one mode of operation
- C. Stand Alone Capability: BC shall continue to perform all functions independent of a failure in other BC/AAC/ASC or other communication links to other BCs/AACs/ASCs. Trends and runtime totalization shall be retained in memory. Runtime totalization shall be available on all digital input points that monitor electric motor status. Refer also to Section 15953for other aspects of stand-alone functionality.
- D. Operating System: Controllers shall include a real-time operating system resident in ROM. This software shall execute independently from any other devices in the system. It shall support all specified functions. It shall provide a command prioritization scheme to allow functional override of control functions. Refer also to Section 15953 for other aspects of the controllers operating system.
- E. Network Communications: Each controller shall include software/firmware that supports the networking of CUs on a common communications trunk that forms the respective LAN.
- F. Point Database/Summary Table: All points included in the typical equipment point list must be represented to Owner's WAN in a common, open protocol format. Naming conventions for these points and network addressing are discussed in Part III of this section. Point/system database creation and modification shall be via a user-friendly, menu-driven program. System software shall support virtual or logic point (points not representing a physical I/O) creation. Software shall support virtual points with all services specified herein. Database software shall support definition of all parameters specified in Part III of this section for a given point type. If database does not support all of these parameters software module shall be created and attached to the points which accomplish the respective function.
- G. Diagnostic Software: Controller software shall include diagnostic software that checks memory and communications and reports any malfunctions
- H. Alarm/Messaging Software: Controller software shall support alarm/message processing and buffering software as more fully specified below.
- I. Direct Digital Control: Controller shall support application of Direct Digital Control Logic. All logic modules shall be provided pre-programmed with written documentation to support their application. Provide the following logic modules as a minimum:
 - 1. Proportional-Integral-Derivative (PID) control with analog, PWM and floating output
 - 2. Two Position control (Hi or Low crossing with deadband).
 - 3. Single-Pole Double-Throw relay.

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- 4. Delay Timer (delay-on-make, delay-on-break, and interval).
- 5. Hi/Low Selection.
- 6. Reset or Scaling Module.
- 7. Logical Operators (And, Or, Not, Xor).

2.3 APPLICATION PROGRAMMING DESCRIPTION

A. Existing.

PART 3 - EXECUTION

3.1 SYSTEM CONFIGURATION

A. Contractor shall thoroughly and completely configure BAS system software, supplemental software, network communications, CSS, OWS, remote operator workstation, portable operators terminal, printer, and remote communications.

END OF SECTION

BAS COMMISSIONING

PART 1 - GENERAL

- 1.1 RELATED SECTIONS:
 - A. Drawings and general provisions of the Contract, including Conformed General Conditions and Special Conditions, Division1, Division 15 and Division 16 Specification Sections, apply to this Section.
 - B. Section 15950 BUILDING AUTOMATION SYSTEM (BAS) GENERAL
 - C. Section 15951- BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS
 - D. Section 15952 BAS OPERATOR INTERFACES
 - E. Section 15953 BAS FIELD PANELS
 - F. Section 15954 BAS COMMUNICATION DEVICES
 - G. Section 15980 SEQUENCES OF OPERATION

1.2 GENERAL DESCRIPTION

A. This section defines responsibilities of the Controls Contractor to commission the BAS. This commissioning applies to new equipment that is installed as part of this HVAC and control upgrade project.

1.3 CONTRACTOR RESPONSIBILITIES

- A. Completely install and thoroughly inspect, startup, test, adjust, balance, and document all systems and equipment.
- B. Compensation for Retesting: Contractor shall compensate Owner for site time necessitated by incompleteness of systems or equipment at time of point to point functional and system performance testing. All critical testing failures as determined by CLIENT'S project manager and Energy Management Dept., which require on-site time for retesting, will be considered actual damages to the Owner. All parties under contract with the Owner who are affected by the retesting shall be included in the contract modification. Functional testing will commence 30 days prior to substantial completion.

1.4 SEQUENCING

- A. The following list outlines the general sequence of events for submittals and commissioning:
 - 1. Submit product data and shop drawings, and receive approval.
 - 2. Submit BAS logic documentation, and receive approval.
 - 3. Submit background graphic screens, and receive approval.
 - 4. Submit Start-Up Checklists and manufacturer's start-up procedures for all equipment provided by the BAS Contractor.
 - 5. Install BAS.
 - 6. Submit BAS Start-Up Test Agenda and Schedule for review.
 - 7. Receive BAS Startup Test Agenda/schedule approval.

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- 8. Submit Training Plan.
- 9. Simulate sequencing and debug program off-line to the extent practical.
- 10. Place systems under BAS control where applicable during a scheduled outage.
- 11. Perform BAS Startup where applicable during a scheduled outage.
- 12. Prepare and initiate trend log data storage and format trend graphs.
- 13. Submit completed BAS Start-Up Reports and initial draft of the O&M Manuals.
- 14. Submit Trend Logs in format specified.
- 15. Receive demonstration approval and approval to schedule Acceptance Period.
- 16. Substantial Completion
- 17. Begin Acceptance Phase.
- 18. Two-week Operational Test.
- 19. Perform Functional Performance Testing.
- 20. Receive Acceptance Period approval, which is Functional Completion for the BAS.
- 21. Provide Level 1 (Admin Level) password access to the Owner.
- 22. Revise and re-submit as-built record drawings and O&M Manuals.
- 23. Final Acceptance.
- 24. Begin Warranty Phase.
- 25. Schedule and begin Opposite Season acceptance period.
- 26. Receive Opposite Season acceptance period approval.
- 27. Submit as-built record drawings and O&M Manuals.
- 28. Install framed control drawings.
- 29. End-of-Warranty date/ period.

PART 2 - PRODUCTS

- 2.1 INSTRUMENTATION
 - A. Instrumentation required to verify readings and test the system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Generally, no testing equipment will be required beyond that required to perform Contractors work under these Contract Documents. All equipment used for testing and calibration shall be NIST/NBS traceable and calibrated within the preceding year. Certificates of calibration shall be submitted.

PART 3 - EXECUTION

3.1 BAS START-UP TESTING, ADJUSTING, CALIBRATION

- A. Work and/or systems installed under this Division shall be fully functioning prior to Demonstration and Acceptance Phase. Contractor shall start, test, adjust, and calibrate all work and/or systems under this Contract, as described below:
 - 1. Inspect the installation of all 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 all circuits are free from faults.
 - 3. Verify integrity/safety of all electrical connections.
 - 4. Contractor shall provide assistance to the TAB contractor to facilitate testing, adjusting, and balancing of the system. Coordinate with TAB subcontractor to obtain, program, and record control settings that are determined from balancing procedures.
 - 5. Test, calibrate, and set all digital and analog sensing and actuating devices. Calibrate each instrumentation device by making a comparison between the BAS display and the reading at the device, using an instrument traceable to the National Bureau of Standards, which shall be at least twice as accurate as the device to be calibrated (e.g., if field device is +/-0.5% accurate, test equipment shall be +/-0.25% accurate over same range). Record the measured value and displayed value for each device in the BAS

Startup Report.

- 6. Check and set zero and span adjustments for all transducers and transmitters.
- 7. Check each digital control point by making a comparison between the control command at the CU 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 Operator Interface display. Record the results for each device in the BAS Start-Up Report.
- 8. 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.
- 9. Verify proper sequences by using the approved checklists to record results and submit with BAS Start-Up Report. Verify proper sequence and operation of all specified functions.
- 10. Verify that all safety devices trip at appropriate conditions. Adjust setpoints accordingly.
- 11. Tune all 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 BAS Startup Report. Except from a startup, maximum allowable variance from set point for controlled variables under normal load fluctuations shall be as follows:
 - a. Chilled Water: ±2°F
 - b. Hot water temperature: $\pm 2^{\circ}$ F.
 - c. Water pressure: ±1 psid
- 12. For interface and DDC control panels:
 - a. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the as-built record drawings.
 - b. Ensure that terminations are safe, secure and labeled in accordance with the as-built 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 and cycling controller power. Verify the event is annunciated at Operator Interfaces. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection and that controller retains its memory.
 - g. Ensure that all outputs and devices fail to their proper positions/states.
 - h. Ensure that buffered and/or volatile information is held through power outage.
 - i. With all 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 all DDC panels and devices.
- 13. For MSIP Interface:
 - a. Verify that all elements on the graphics are functional and are properly bound to physical devices and/or virtual points, and that hot links or page jumps are functional and logical.
 - b. Verify that the alarm reporting and logging is functional and per requirements.
 - c. Verify that trends are configured and are archiving to disk as required.
- 14. Verify proper interface with fire alarm system.
- B. Submit Start-Up Test Report: Report shall be completed, submitted, and approved prior to Substantial Completion.

3.2 SENSOR CHECKOUT AND CALIBRATION

A. General Checkout: Verify that all sensor locations are appropriate and are away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they

are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading of each other for pressure. Tolerances for critical applications may be tighter.

- B. Calibration: Calibrate all sensors using one of the following procedures:
 - 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 BAS) is within the tolerances specified for the sensor. If not, adjust offset and range, or replace sensor. Where sensors are subject to wide variations in the sensed variable, calibrate sensor within the highest and lowest 20% of the expected range.
 - 2. <u>Sensors With Transmitters Standard Application:</u> Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until the ammeter reads 4 mA. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the OI. Record all values and recalibrate controller as necessary to conform to tolerances. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or BAS) is within the tolerances specified. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.
- C. Sensor Tolerance: Sensors shall be within the tolerances specified for the device. Refer to Section 15951.

3.3 COIL VALVE LEAK CHECK

A. Verify proper close-off of the valves. Ensure the valve seats properly seat by simulating the maximum anticipated pressure difference across the circuit. Calibrate air temperature sensors on each side of coil to be within 0.5°F of each other. Via the Operator Interface, command the valve to close. Energize fans. After 5 minutes or longer, and the temperature is stable, observe air temperature difference across coil. If a temperature difference is indicated, and the piping surface temperature entering the coil is within 3°F of the water supply temp, leakage is probably occurring. If it appears that it is occurring, close the isolation valves to the coil to ensure the conditions change. If they do, this validates 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.

3.4 VALVE STROKE SETUP AND CHECK

- A. For all valve and actuator positions checked, verify the actual position against the Operator Interface readout.
- 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 doesn't reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

3.5 BAS DEMONSTRATION

A. Demonstrate the operation of the BAS hardware, software, and all related components and systems to the satisfaction of the Owner prior to Substantial Completion. Schedule the demonstration with the Owner's representative 2 weeks in advance. Demonstration shall not be scheduled until all hardware and software submittals, and the Start-Up Test Report are approved. If the Work fails to be demonstrated to conform to Contract specifications.

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- B. The Contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etc. Contractor-supplied personnel must be competent with and knowledgeable of all project-specific hardware, software, and the HVAC systems. All training documentation and submittals shall be at the job site.
- C. Demonstration shall typically involve small representative samples of systems/equipment randomly selected by the Owner.
- D. The system shall be demonstrated following the same procedures used in the Start-Up Test by using the approved Checklists. Demonstration shall include, but not necessarily be limited to, the following:
 - 1. Demonstrate that required software is installed on BAS Operator Interfaces.
 - 2. Demonstrate that points specified and shown can be interrogated and/or commanded (as applicable) from all Operator Interfaces and the MSIP, as specified.
 - 3. Where required, demonstrate that remote communication abilities are in accordance with these Specifications.
 - 4. 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 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 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.
 - 5. Demonstrate that all DDC and other software programs exist at respective field panels. The Direct Digital Control (DDC) programming and point database shall be as submitted and approved.
 - 6. Demonstrate that all DDC programs accomplish the specified sequences of operation.
 - 7. Demonstrate that the panels automatically recover from power failures, as specified.
 - 8. 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.
 - 9. Identify access to equipment and demonstrate that access is sufficient to perform required maintenance.
- E. BAS Demonstration shall be completed and approved prior to Substantial Completion.
- F. Any tests successfully completed during the demonstration will be recorded as passed for the functional performance testing and will not have to be retested.

3.6 BAS ACCEPTANCE PERIOD

- A. 30 days prior to substantial completion, BAS demonstration shall commence. The Acceptance Period shall not be scheduled until all HVAC systems are in operation and have been accepted; including all required cleaning and lubrication completed (i.e., filters changed, piping flushed, strainers cleaned, and the like), and TAB report has been submitted and approved.. If the HVAC systems are not ready for testing at the beginning of the 30 days prior to substantial completion, the General Contractor will be responsible.
- B. Operational Test: Prior to 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, contractor shall forward the trend logs to the Owner for review. Owner shall determine if the system is ready for functional performance testing and document any problems requiring contractor attention.
- C. During the Acceptance Period, the contractor shall maintain a hard copy log of all alarms

generated by the BAS. For each alarm received, Contractor shall diagnose the cause of the alarm, and shall list on the log for each alarm, the diagnosed cause of the alarm, and the corrective action taken. If in the Contractor's opinion, the cause of the alarm is not the responsibility of the Contractor, Contractor shall immediately notify the Owner's representative.

3.7 TREND LOGS

A. Contractor shall configure and analyze all trends required under Section 15955 & 15985.

3.8 TREND GRAPHS

- A. Trend graphs as specified in Section 15955 & 15985 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.

3.9 WARRANTY PHASE BAS OPPOSITE SEASON TRENDING AND TESTING

- A. Trending: Throughout the Warranty Phase, trend logs shall be maintained as required for the Acceptance Period. Contractor shall forward archive trend logs to the Owner for review upon Owner request. Owner will review these and notify contractor of any warranty work required.
- B. Opposite Season Testing: Within 12 months of completion of the Acceptance Phase, Owner shall schedule and conduct Opposite Season functional performance testing. Contractor shall participate in this testing and remedy any deficiencies identified.

END OF SECTION

SEQUENCES OF OPERATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including Conformed General Conditions and Special Conditions, Division1, Division 15 and Division 16 Specification Sections, apply to this Section.
- B. Section 15781 Heat Pump Rooftop
- C. Section 15950 BUILDING AUTOMATION SYSTEM (BAS) GENERAL
- D. Section 15959 BAS COMMISSIONING
- E. Section 15951- BAS BASIC MATERIALS, INTERFACE DEVICES, AND SENSORS
- F. Section 15952 BAS OPERATOR INTERFACES
- G. Section 15954 BAS COMMUNICATION DEVICES
- H. Section 15953 BAS FIELD PANELS
- I. Section 15955 & 15985 BAS SOFTWARE AND PROGRAMMING

1.2 SYSTEM DESCRIPTION

- A. This Section defines the manner and method by which the controls operate and sequence the controlled equipment. Included in this section are general requirements and logic strategies that expand on the specific sequences shown on the drawings.
- B. Refer to the control drawings for specific sequences of operation. Each control drawing includes the following:
 - 1. Design Intent: A brief outline of the purpose and the design engineer's expectations for the system.
 - 2. Detailed Sequence of Operation: References may be made to specific logic strategies defined in this section.
 - 3. Points List: The points list defines the analog and digital inputs and outputs to the BAS:
 - a. The points list does not identify field interlocks and may show a single Point that controls multiple field devices. Any required interlocks are identified in the written sequence or the controls schematic.
 - b. The number of field devices controlled shall be determined by the sizes of equipment scheduled on the mechanical drawings and the type of components selected by the BAS Contractor. An example is damper actuators, the points lists will identify a single analog output point, the schematic may show one or two actuators, but the size of the unit and the actuators may dictate that multiple actuators are required.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION

3.1 GENERAL

- A. Sequences specified herein and on the drawings indicate the standard and functional intent of the systems operation and may not fully detail every aspect of the programming that may be required to obtain the indicated operation. Majority of this sequences (see section 3.07 for more details) are already programmed and the software is installed, and is currently operational. Refer to above section and drawings for new scope of controls work.
- B. Contractor shall provide all programming necessary to obtain the sequences/system operation indicated.
- C. All setpoints and control parameters shall be adjustable both from any operator interface, without any required re-programming of software code.
- D. All control loops shall utilize PID control algorithms unless otherwise specified in the sequence of operation. Throttling ranges, proportional bands, and cycle differentials shall be centered on the associated. All modulating feedback control loops shall include the capability of having proportional, integral, and derivative action. Unless the loop is specified "proportional only" or "P+I", Contractor shall apply appropriate elements of integral and derivative gain to each control loop which shall result in stable operation, minimum settling time, and shall maintain the primary variable within the specified maximum allowable variance.
- E. Safeties:
 - 1. All HVAC safeties shall be hardwired such that the shutdown will occur both in Automatic and Hand modes at the BAS system and the starter. Software safeties are not acceptable.
 - 2. Exception: All automatic reset type freeze protection thermostats shall have a separate DDC input and shall shutdown and lockout the system as specified. Provide a freeze alarm reset button on the BAS workstation graphic.
- F. When air handling units are not in operation, control devices shall remain in their OFF positions. OFF positions may differ from the NORMAL (meaning failed) position. Except as specified otherwise, OFF and NORMAL positions of control devices shall be as follows:

Device	OFF Position	NORMAL Position
Outside air damper	Closed	Closed
Exhaust air damper	Closed	Closed
Return air damper	Open	Open
HW Valves	Closed	Closed
CHW Valves	Closed	Closed

- G. Where any sequence or occupancy schedule calls for more than one motorized unit to start simultaneously, the BAS start commands shall be staggered by 5 second (adj.) intervals to minimize inrush current.
- H. Where reset action is specified in a sequence of operation, but a reset schedule is not indicated, one of the following methods shall be employed:
 - 1. Contractor shall determine a fixed reset schedule which shall result in stable operation and shall maintain the primary variable within the specified maximum allowable variance.
 - 2. A floating reset algorithm shall be used which increments the secondary variable setpoint (setpoint of control loop being reset) on a periodic basis to maintain primary

variable setpoint. The recalculation time and reset increment shall be chosen to maintain the primary variable within the specified maximum allowable variance.

- 3. For whichever reset strategy is incorporated, provide a summary of reset operation on the associated system graphic. Information displayed shall include: controlled variable value, compensation variable value, reset ranges, etc.
- I. Where a supply air temperature setpoint is specified to be reset by the space temperature of the zones calling for the most cooling/heating, the following method shall be employed:
 - 1. A floating reset algorithm shall be used which increments the secondary variable (e.g., supply air temperature or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g. space temperature) setpoint. The reset increment shall be determined by the quantity of "need heat" or "need cool" requests from individual Terminal Controller. A Terminal Controller's "need heat" virtual point shall activate whenever the zone's space temperature falls below the currently applicable (occupied or unoccupied) heating setpoint throttling range. A Terminal Controller's "need cool" virtual point shall activate whenever the zone's space temperature falls below the currently applicable (occupied or unoccupied) heating setpoint throttling range. A Terminal Controller's "need cool" virtual point shall activate whenever the zone's space temperature rises above the currently applicable (occupied, unoccupied, or economy) cooling setpoint throttling range. The recalculation time and reset increment shall be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time. Reset range maximum and minimum values shall limit the setpoint range.
- J. Where a supply air temperature, or differential water pressure setpoint is specified to be reset by valve or damper position of the zone or zones calling for the most cooling/heating, the following method shall be employed:
 - 1. A floating reset algorithm shall be used which increments the secondary variable (e.g., supply air temperature, pipe or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g. cooling valve, heating valve, damper position) setpoint of 85% open. The reset increment shall be calculated based on the average position of the quantity of the worst (most open valve/damper) zone(s) as specified. The recalculation time, reset increment and control device position influence shall be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time. The BAS analog output value shall be acceptable as indicating the position of the control device.
 - 2. Alternatively to continuously calculating the average of the quantity of worst valve/damper positions, a method similar to the one described above may be employed whereby the "need heat" or "need cool" virtual point shall increment by one unit each time a zone's valve/damper position rises to greater than 95%. The quantity of "need heat" or "need cool" points shall then be the basis for reset.
- K. Where "prove operation" of a device (generally controlled by a digital output) is indicated in the sequence, it shall require that the BAS, after an adjustable time delay after the device is commanded to operate (feedback delay), confirm that the device is operational via the status input. If the status point does not confirm operation after the time delay or anytime thereafter for an adjustable time delay (debounce delay) while the device is commanded to run, an alarm shall be enunciated audibly and via an alarm message at the operator interface and print at the alarm printers. A descriptive message shall be attached to the alarm message indicating the nature of the alarm and actions to be taken. Contractor shall provide messages to meet this intent.
- L. BAS shall provide for adjustable maximum rates of change for increasing and decreasing output from the following analog output points:
 - 1. Speed control of variable speed drives
 - 2. Any temperature setpoint reset
 - 3. Travel rate of tower isolation valves

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SEQUENCES OF OPERATION

- M. Wherever a value is indicated to be dependent on another value (i.e.: setpoint plus 5°F) BAS shall use that equation to determine the value. Simply providing a virtual point that the operator must set is unacceptable. In this case three virtual points shall be provided. One to store the parameter (5°F), one to store the setpoint, and one to store the value which is the result of the equation.
- 3.2 AIR HANDLING/FAN COIL UNITS SCHEDULES AND OPERATING MODES
 - A. As-is operation.
- 3.3 AIR HANDLING/FAN COIL UNITS MONITORING AND MANAGEMENT
 - A. As-is operation.
- 3.4 Central plant equipment MONITORING AND MANAGEMENT
 - A. As-is operation.
- 3.5 Condenser water controls
 - A. As-is operation.
- 3.6 EXHAUST FAN CONTROL
 - A. A. As-is operation.
- 3.7 SEQUENCES OF OPERATION:
 - A. This section provides the sequences of operation for each HVAC system. The organization of the sequences for each system are:
 - B. Design Intent:
 - 1. This contains a brief outline of the purpose and the design engineer's expectations for the system.
 - C. Sequences:
 - 1. The sequences are generally divided into smaller sequences for each component of the larger HVAC System.
 - 2. The concept is that each of these smaller sequences operates essentially independently, although together they integrate into the larger System.
 - D. Points Lists:
 - 1. The points list which describes the analog and digital inputs and outputs to the Building Automation System, shall be prepared by the Building Automation System Contractor and be submitted to the Engineer for review and approval.
 - 2. The points lists do not identify field interlocks and often times they will show a single Point that may control multiple field devices.
 - 3. The interlocks are identified in the written sequence.
 - 4. The number of field devices controlled shall be determined by the sizes of equipment scheduled on the mechanical drawings and the type of components selected by the Building Automation System Contractor. An example is damper actuators, the points lists will identify a single analog output point, the P&IDs may schematically show one or two actuators, but the size of the unit and the actuators dictates that multiple actuators are required.
 - E. This base point list is presented as a minimum requirement and as a guideline. Building

SEQUENCES OF OPERATION

Automation System Contractor is responsible for providing complete sets of points that will satisfy the requirements of the sequence of operation and proper operation of the entire HVAC system.

- F. Except as noted, total HVAC system shall be controlled by the full DDC system via BAS.
- G. COOLING SYSTEM
 - 1. General:

a.

BAS contractor shall include in its bid the price to connect new rooftop air conditioning units, and their corresponding thermostats/sensors; the new reheat coils, and their corresponding sensors; split system AC units; to existing BAS controller along with all components and accessories and exhaust fans. All new units shall start/stop and be monitored by BAS and be interlocked with new exhaust fans. BAS shall monitor space temperature for each unit and send alarm to building controller when the temperature is below (heating) or above (cooling) setpoint. BAS shall monitor supply and return air temperatures from each unit and send alarm to building controller when the unit fan fails and the temperature settings are not met.

H. HEATING HOT WATER SYSTEM

- 1. The hot water system and its sequence, shall function as-is.
- I. SPACE TEMPERATURE CONTROL (RTU's)
 - 1. RTU's are energized and de-energized via DDC control system and shall operate continuously during occupied mode. DDC room sensors will stage compressors to maintain room temperature setpoint (adjustable) for both cooling and heating operation.
 - 2. RT units shall be de-energized (fan shut down) as a first priority by their respective smoke detectors. Smoke detectors shall be provided and installed by Division 16. All air moving devices shall completely and automatically shut down once smoke is detected by smoke detector. Activation of it in any of the Units shall shut down other units that fully or partially serve the connected space (below or above ceiling). The smoke detector shall be wired to shut down air moving devices (supply fan, return/relief fan, etc.) only. The power shall not shut down and disable the entire unit and its control module.
 - 3. Room sensor will initiate night set back cycle and heating operation of the unit, by fully closing electric/ electronic actuated outside air damper when room temperature is below 50°F (adjustable). A return temp. sensor will initiate morning warm up cycle by fully closing electric/ electronic actuated outside air damper when return air temperature is below 70°F (adjustable). DDC controller shall energize the unit/fan when needed to satisfy the setpoint for these cycles.
 - 4. Central control module will fully close the outside air damper, energize the fan, initiate cooling operation for morning start up/cool down cycle when return air temperature is above 75°F (adjustable). This cycle shall be programmed and scheduled for cooling season for duration of time (adjustable) prior to occupied schedule. Outside air damper shall be closed by controller when fan is de-energized and /or the units are in night set back, morning warm up or morning start up mode. Fan status shall be monitored through control module.
 - 5. Relief/ exhaust fan shall be enabled when RTU is in occupied mode. This fan shall move from minimum to maximum CFM (see schedules), to match the economizer damper position.
 - 6. Economizer control shall be initiated only during cooling operation, and when outside air temperature is below return air temperature. Return air damper will modulate to full open to exhaust and outside air damper will modulate to full open, to maintain the space temperature set point. Compressors shall be staged to maintain cooling setpoint as required.
 - 7. The unit will remain off during unoccupied periods, unless unit is initiated for night set

back, early morning warm up or cool down function.

- J. SPLIT SYSTEM AIR CONDITIONING UNITS (AC/FC Unit)
 - 1. New split heat pump units (AC/FC-M1), serving IDF Room shall have non-adjustable room temperature sensors with EMS connection for temperature monitoring only, and be set at 72 degree F(adjustable). This unit shall be energized and de-energized via local controls (space thermostat) and shall operate continuously (24/7).
- K. EXHAUST FANS
 - 1. This system shall operate as described below. New exhaust fan EF-M1 shall be interlocked with existing AH-5 unit and function as the existing fans in the building are programmed for start/stop/status and monitoring, as applicable.
 - 2. EF-M2, serving Electrical room shall operate via local controls (room sensor) and shall be connected to EMS for monitoring only. These fans shall maintain room temperature setpoint (adjustable).

END OF SECTION

SYSTEM VERIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division Specification sections, apply to work of this section.
- B. Section 15050 Basic Mechanical Materials and Methods.

1.2 DESCRIPTION OF WORK

- A. After testing, adjusting, and balancing has been performed; and after the plumbing contractor have corrected deficiencies, Systems Verification will demonstrate the proper operation of systems to the Owner's representative.
- B. The contractor shall make adjustments and/or modifications to the systems as directed by the Owners representative.
- C. The Contractor shall make the following instruments available for Systems Verifications:
 - 1. Thermometers (Digital readout type)
 - 2. Pressure Gauges
 - 3. Tachometer
 - 4. Ammeter
 - 5. Voltmeter

1.3 PROCEDURE

- A. The date for the Systems Verification is to be coordinated with the Owner's representative and shall be no later than two weeks prior to occupancy date.
 - 1. The contractor shall notify Owner/Architect when all systems are ready for systems verification.
 - 2. The General contractor shall arrange the schedule for all parties involved, including representatives of the Owner. The General contractor shall be responsible for the attendance of required subcontractors.
- B. Prior to Systems Verification, the General Superintendent shall meet with Owner/Architect to coordinate schedules and perform tests:
- C. The contractors shall provide all necessary shop drawings as many as requested by Owner/Architect for reference during verification.
- D. The Engineer shall review with the contractors, the content and quality of instructions provided on major equipment, controls, etc. Additional instructions, if any, will be identified and will be scheduled.
- E. The Contractor shall conduct activities and observations listed in the Method section following.
- F. Method:
 - 1. Execute start-up under supervision of the manufacturer or responsible Contractors' personnel in accordance with manufacturers' printed instructions.

SYSTEM VERIFICATION

- 2. Submit a written report that systems have been properly installed and are functioning correctly.
- 3. Deliver reproducible "Record Drawings".
- 4. Deliver Guarantee and manufacturer's warranties.
- 5. Deliver Operating and Maintenance manual.
- 6. Arrange instructions for the Owner and its personnel to thoroughly familiarize them with the operations and maintenance of the systems.

PART 2 - PRODUCTS - NOT USED.

PART 3 - EXECUTION - NOT USED.

END OF SECTION

SYSTEM VERIFICATION

TESTING, ADJUSTING, AND BALANCING (By Owner)

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Testing, Adjusting, and Balancing HVAC systems will be performed by a specialized firm contracted separately by the Owner.
- C. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
 - 1. Balancing airflow and water flow within distribution systems, including sub mains, branches, and terminals, to indicated quantities according to specified tolerances.
 - 2. Adjusting total HVAC systems to provide indicated quantities.
 - 3. Setting quantitative performance of HVAC equipment.
 - 4. Measuring Equipment vibration.
 - 5. Reporting results of the activities and procedures specified in this Section.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING:

- A. Document AIA A201 General Conditions: Inspections, tests, and approvals required by public authorities.
- B. Document AIA A201 General Conditions
- C. Division 1 Quality Control
- D. Division 1 Testing Laboratory/Agency Services
- E. Division 1 Starting of Systems
- F. Division 1 System Demonstration
- G. Division 1 Testing, Adjusting, and Balancing
- H. Individual Sections: Qualification of testing organization; specific services required. Where there is any conflict of services or directions between Sections regarding the Testing and Balancing of Systems, contact the Architect immediately.

1.3 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including sub mains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of

highAir velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

- D. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a Closed system, static head is equal on both sides of the pump.
- E. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- F. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- G. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- H. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- I. Test: A procedure to determine quantitative performance of a system or equipment.
- J. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- K. AABC: Associated Air Balance Council.
- L. AMCA: Air Movement and Control Association.
- M. CTI: Cooling Tower Institute.
- N. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Draft Reports: prior to commencing work, submit a detailed agenda of balancing procedures for this project. Include a draft report utilizing proper and relevant report forms appropriate to the procedures. The forms shall be essentially completed with design criteria and approved performance data of the equipment approved for use. This shall be representative of the information to be included in the final report. Accompanying this agenda/draft report shall be a complete set of approved performance submittal data on equipment relevant to the HVAC systems, etc. Also, submit the AABC National Project Performance Guarantee, or the acceptable equivalent thereof.
- C. Test Reports: Prior to the final acceptance of the project, submit for approval and for inclusion into the operating and maintenance manuals. Provide the report in six copies, letter size, spiral-type (3-ring for larger reports) permanent binder, with index page, tabs, with cover identification. The report shall also include a significant General Comments section identifying unusual or incomplete final conditions that could not be remedied fully or satisfactorily. This shall also summarize such significant data that may appear on individual test data sheets. Included in the report shall be reduced scale drawings with air outlets and equipment identified to correspond to the data sheets but also the final as-built, contract drawings with respect to mark numbers, room numbers and other significant physical I.D., etc. Also show final locations of thermostats, sensing elements and duct traverses. The report shall provide evidence that all reasonable efforts on the part of the TABA and the related trades shall have been performed sufficiently to remedy any remaining deficiencies. The report shall include an appendix with copies of all Site

Inspection Reports (or equivalent thereof) issued by the TABA and the responses by any and all parties, relevant to the Inspection Reports. In addition, shall there have been RFI's &- Change Orders affecting the TAB work, they shall be included.

- D. Copies of the approved performance curves, charts, etc., on all fans, coils, RTU's, etc. shall be included in a separate section or appendix of the TAB report. It is the responsibility of the Architect and Consulting Engineer to provide "approved" copies of the appropriate submittal/performance data of the equipment involved in the installation. They shall also provide copies of the appropriate drawings and specifications, addenda, change borders, etc., required by the TABA to perform their work.
- E. Report Forms: Forms utilized shall be significantly similar to the forms of the AABC National Standards.

1.5 QUALIFICATION AND QUALITY CONTROL

- A. All work shall be performed per the National Standards (latest edition) of the Associated Air Balance Council (AABC) and the AABC Procedures Manual; these shall be considered the minimum criteria. Agencies shall be certified by AABC and all work shall be performed under the direct field supervision of an AABC certified TBE.
- B. The successful TABA shall be immediately provided with the necessary contract drawings, approved submittal data, etc., required to enable their critique of the contract drawings, addenda and specifications with respect to determining the "balance-ability" of the systems. This report shall be given to the Owner, Architect and Engineer. The TABA shall expedite this important aspect of TAB services.

1.6 GENERAL SCOPE OF WORK

- A. Testing, Adjusting and Balancing of the heating, ventilating and air conditioning (HVAC) systems.
- B. All work shall be performed per the National Standards (latest edition) of the Associated Air Balance Council (AABC) and shall be considered the minimum criteria. These Standards are to be used and applied on the appropriate scope of the systems utilized and installed in and on this project. The TABA shall be totally familiar with these Standards and further detailed directions will not be provided unless specifically stated herein.
- C. Test & Balance Agencies (TABA) shall be certified by the AABC, and all work shall be performed under the direct field supervision of an AABC certified TBE. All TABA firms shall have a permanent office in So. Nevada, locally manned with certified personnel and a Test & Balance Engineer. The TABA shall have been a member agency in good standing with their association for a minimum of three (3) years.

1.7 PROJECT CONDITIONS

- A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.
- B. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.8 COORDINATION

- A. Contractor and the Contractor's representatives shall coordinate the systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.
- C. Commissioning Agency will coordinate with TABA.

1.9 RESPONSIBILITY OF CONTRACTOR

- A. Should the TABA be unable to perform his work or be required to redo his work because HVAC System(s) (elements, components or subsystems) are not ready or are improperly installed, any additional costs, herein related and approved by the owner, shall be back charged to the Contractor.
- B. Contractor and all Sub-Contractors shall cooperate fully with the TABA to efficiently complete the systems and their balancing.
- C. Other than their instrumentation, gauges, etc., the TABA shall not provide nor install any devices or components. It is the responsibility of the Contractor to ensure the necessary assistance and coordination is provided which shall include (but not limited to):
 - 1. Calibration of all controls (includes providing of instrumentation and software necessary to the operation of same, i.e. computers, etc.), providing and installing of drives, dampers, filters, access, test holes, gauges and taps (properly located), sealing of holes and insulation, removal and replacement of ceiling and/or tiles, water systems cleaned and flushed, duct leakage and pressure testing, proper motor starters and heaters installed, volume, fire and smoke/fire dampers, diffusers, grilles. All duct-mounted dampers shall be placed and locked in a full open position and clearly "flagged" for ease of location. The ceiling tile shall be clearly and permanently ID' d, for everyone's knowledge of access. Hard ceilings shall be provided with permanent access. Where required the contractor(s) shall provide the necessary and adequate lifts and scaffolds.
 - 2. All systems shall be checked, tested and started prior to turning them over to the TABA, and the report of same, in writing, provided to the TABA, as well as the owner. Contractor shall have a competent technician or tradesmen available during the testing and balancing of the systems. There shall be an HVAC technician, fully familiar with the systems, on site full time during the work of the TABA.
 - 3. The installing contractors shall provide duct mounted volume dampers for each main zone duct on a MZ unit, as well as branch dampers for each main branch duct and subsequent branch ducts and run outs to each supply, return and exhaust air distribution devices, whether shown on the drawings or not. Essentially, the installing contractor(s) shall provide the dampers necessary for the TABA to properly balance the systems.
- D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- E. Examine strainers for clean screens and proper perforations.
- F. Examine control valves for proper installation for their intended function of fluid flows.
- G. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- H. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

- I. Examine equipment for installation and for properly operating safety interlocks and controls.
- J. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- K. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices operate by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multi-zone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to design values.

1.10 REPORT FORMS

- A. Submit reports on AABC National Standards for Total System Balance.
- B. Forms shall include the following information:
 - 1. Title Page:
 - a. Company name
 - b. Company address
 - c. Company telephone number
 - d. Project name
 - e. Project location
 - f. Project Engineer
 - g. Project Contractor
 - h. Project altitude
 - 2. Instrument List:
 - a. Instrument
 - b. Manufacturer
 - c. Model
 - d. Serial number
 - e. Range
 - f. Calibration date
 - 3. Air Moving Equipment:
 - a. Location
 - b. Manufacturer
 - c. Model
 - d. Air flow, specified and actual
 - e. Return air flow, specified and actual
 - f. Outside air flow, specified and actual
 - g. Total static pressure (total external), specified and actual
 - h. Inlet pressure
 - i. Discharge pressure

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- j. Fan RPM
- 4. Return Air/Outside Air Data:
 - a. Identification/location
 - b. Design air flow
 - c. Actual air flow
 - d. Design return air flow
 - e. Actual return air flow
 - f. Design outside air flow
 - g. Actual outside air flow
 - h. Return air temperature
 - i. Outside air temperature
 - j. Required mixed air temperature
 - k. Actual mixed air temperature
 - I. Design outside/return air ratio
 - m. Actual outside/return air ratio
- 5. Electric Motors:
 - a. Manufacturer
 - b. HP/BHP
 - c. Phase, voltage, amperage; nameplate, actual, no load.
 - d. RPM
 - e. Service factor
 - f. Starter size, rating, heater elements
 - g. V-Belt Drive:
 - h. Identification/location
 - i. Required driven RPM
 - j. Driven sheave, diameter and RPM
 - k. Belt, size and quantity
 - I. Motor sheave, diameter and RPM
 - m. Center to center distance, maximum, minimum, and actual
- 6. Duct Traverse:
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air temperature
 - j. Air correction factor
- 7. Air Distribution Test Sheet:
 - a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Area factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
 - j. Percent of design air flow
- 8. Cooling Coil Data:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer

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- e. Air flow, design and actual
- f. Entering air DB temperature, design and actual
- g. Entering air WB temperature, design and actual
- h. Leaving air DB temperature, design and actual
- i. Leaving air WB temperature, design and actual
- j. Air pressure drop, design and actual
- k. Water flow, design and actual (if applicable)
- I. Water pressure drop, design and actual (if applicable)
- m. Entering water temperature, design and actual (if applicable)
- n. Leaving water temperature, design and actual (if applicable)
- 9. Heating Coil Data:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Entering air temperature, design and actual
 - g. Leaving air temperature, design and actual
 - h. Air pressure drop, design and actual
 - i. Water flow, design and actual
 - j. Water pressure drop, design and actual
 - k. Entering water temperature, design and actual Leaving water temperature, design and actual
- 1.11 WARRANTY
 - A. General Warranty.
 - B. Provide one-year full warranty from date of, Substantial Completion.
- PART 2 PRODUCTS NOT APPLICABLE

PART 3 - EXECUTION

- 3.1 EXAMINATIONExamine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - B. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 - C. Examine approved submittal data of HVAC systems and equipment.
 - D. Examine project record documents described in Division 1 Section "Project Record Documents."
 - E. Examine system and equipment test reports.
 - F. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and

fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

- G. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing, and Report all deficiencies to Architect/Owner.
- H. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- J. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures to Architect/Owner.

3.2 PREPARATION

- A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures:
 - 1. Before commencing work, as best as can be done, verify that systems are complete, operable and ready to balance. The TABA shall not begin their work until they (and the Owner) have received, in writing, from the installing contractors and the commissioning agency, that all of the systems have been completed, checked, tested and started and are completely ready for the TABA to begin their work.
- B. The TABA shall make a minimum of three (3) site inspection visits during the systems installation. A written report (Site Inspection Report) of these inspections shall be sent to the Owner, Architect, Consulting Engineer and Contractor(s).
- C. During the course of the work performed by the TABA, they shall provide Site Inspection Reports, daily if necessary, which shall report any defects, deficiencies or abnormal conditions observed in the systems, which may prevent systems balance, or compromise the proper operation of the systems. These reports shall be sent via fax, Email, by the following workday, to the Owner, Architect, Consulting Engineer and Contractor(s). Additionally, the prime Contractor shall provide a three-ring binder, on site, wherein copies of these reports/inspections shall be placed for the use of the contractors, inspectors or others.
- D. Each of the above-notified parties shall document acceptance and receipt of these Reports by signing same, and returning that document to the owner or his representative and the TABA.
- E. Recorded data shall represent actually measured or observed conditions and appropriate ambient conditions.
- F. The intent and goal of testing and balancing is to have a completed system(s) functioning per design and has no deficiencies. The fullest cooperation between the TABA, Commissioning Agency and the Contractor and his trades is essential.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section.
- B. The TABA shall permanently mark settings of valves, dampers and other adjustment devices. Set and lock memory stops and mark them. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators,

fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder (6copies), tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing Engineer.
- C. Include a list of the instruments used for procedures, along with proof of calibration.
- D. Final Report Contents: In addition to the certified field report data, include the following:
 - 1. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
 - 5. All sight inspection and deficiency reports done by TABA.
- E. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of testing, adjusting, and balancing Agent.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name, address, and approval stamp.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of testing, adjusting, and balancing Agent who certifies the report.

END OF SECTION

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

- 1.1 SECTION INCLUDES
 - A. Basic Electrical Requirements specifically applicable to Division 16 Sections, in addition to Division 1 General Requirements.

1.2 REFERENCES

- A. ANSI/NFPA 70 National Electrical Code 2011.
- B. UNLV Campus Design and Project Management Manual.

1.3 SUBMITTALS

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements.
- B. Proposed Products List: Include Products specified in the following Sections:
 - 1. Section 16060 Grounding and Bonding.
 - 2. Section 16131 Cabinets and Enclosures.
 - 3. Section 16140 Wiring Devices.
 - 4. Section 16141 Floor Boxes.
 - 5. Section 16411 Enclosed Switches.
 - 6. Section 16441 Switchboards.
 - 7. Section 16442 Panelboards.
 - 8. Section 16461 Dry Type Transformers.
 - 9. Section 16500 Lighting Control Devices.
 - 10. Section 16510 Interior Luminaires.
 - 11. Section 16520 Interior Lighting Solid State Lighting (SSL).
 - 12. Section 16727 Security Access System.
 - 13. Section 13851 Fire Alarm.
- C. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittals.
- D. Mark dimensions and values in units to match those specified.
- E. The Engineer's acceptance applies only to the general quality and arrangement of the items substituted, and not to the exact material which shall be provided under the shop drawings. Submit samples when directed.
- F. Engineer's acceptance of shop drawings shall not be considered as a guarantee of quantities, measurements or building conditions; nor shall it relieve the Contractor of basic responsibilities under the contract.
- G. Substitutions shall comply with the requirements of Section 01630 the contractor shall verify that accepted substitutions will fit into the space available and result in a complete installation equal to that specified, both in appearance and operation. Request for substitutions of lighting fixtures shall include point by point lighting calculations and electronic files in *-IES format of the fixtures Photometrics.

- H. Contractor shall pay the owner for additional submittals reviews past two. Any product reviewed more than twice will not be reviewed the third time unless it is the specified product.
- I. Substitutions will not be accepted based on the contractor's failure to schedule purchase and delivery of the require equipment.
- J. Fax copies are not acceptable for inclusion with Operations and Maintenance submittals.

1.4 REGULATORY REQUIREMENTS

- A. Conform to applicable Building Code.
- B. Electrical: Conform to NFPA 70.
- C. Obtain permits, and request inspections from authority having jurisdiction.
- D. All materials, products, devices, fixtures, forms, or types of construction included in this project shall meet or exceed the published requirements of National Electrical Code (NEC), American National Standards Institute (ANSI), Institute of Electrical and Electronics Engineers (IEEE), National Fire Protection Association (NFPA) 70, 99, 101, 110 and National Electrical Manufacturer's Association (NEMA). All equipment shall bear the Underwriter's (U.L.) label.

1.5 PROJECT/SITE CONDITIONS

- A. Install Work in locations shown on Drawings, unless prevented by Project conditions.
- B. The drawings are diagrammatic unless indicated otherwise. The drawings reflect circuiting only and are not depicting exact conduit routing unless specifically noted otherwise. Homerun circuits may be combined per requirements of NEC. Do not share neutral conductors in Homerun unless specifically noted on Drawings.
- C. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Architect/Engineer before proceeding.
- D. Data presented on these drawings are as accurate as planning can determine, but field verification of all dimensions, locations, levels, etc., to suit field conditions is required. Review all architectural, interior, structural, civil, and mechanical drawings; and adjust all work to meet the requirements of conditions shown. Discrepancies between different plans, or between drawings and specifications, or regulations and codes governing the installation shall be brought to the attention of the engineer in writing before the date of bid opening. If discrepancies are not reported, the contractor shall bid the greater quantity or better quality, and appropriate adjustments will be made after contract award. Contractor shall be responsible to field measure and confirm mounting heights and location of electrical equipment with respect to counters, radiation, etc. Do not scale distances off the electrical drawings. Use actual building dimensions.
- E. Guarantee all material furnished and all workmanship performed for a period of one year from the date of final acceptance of the work. Any defects developing with in this period, traceable to material furnished as a part of this section or workmanship performed hereunder, shall be made good at no additional expense to the owner.

1.6 SEQUENCING AND SCHEDULING

A. Construct work in sequence under provisions of Section 01010.

- B. Work shall be coordinated with other trades under provisions of Section 01310.
- C. The Contractor shall organize his work so that the progress of the electrical work will conform to the progress of other trades, and shall complete the entire installation as soon as the conditions of the building will permit. Any additional work resulting from defective or ill-timed work performed under this section shall be done at no additional cost to the Owner.
- D. This Contractor shall give careful consideration to the work of the General, Heating, Air Conditioning and Plumbing Contractors and other contractors on the job and shall organize his work so that it will not interfere with the work of other trades. He shall consult the drawings and specifications for work of other trades for correction information and the architectural and structural drawings for details and dimensions. This Contractor shall verify the location of all outlets and if interference develops, the Architect/Engineer's decision will be final and not additional compensation will be allowed for the moving of misplaced outlets, wiring, or equipment, and shall provide the proper feeders and connections as recommended by the manufacturer of the equipment.
- E. Work by Owner: Review documents to verify all work done by owner or owner's contractor. Make provisions to allow owner's personnel or owner's contractor access to perform their work.
- F. OWNER FURNISHED PRODUCTS: Provide all necessary equipment and hardware to install owner furnished equipment. Review and inspect all products for damages and quantity prior to accepting at the site. Notify owner within one week of any discrepancies found.
- G. Provide temporary conditions where needed to accommodate the phasing of the work.

1.7 FIELD CHANGE ORDERS

A. All change orders for electrical equipment shall be priced in accordance with Mean's Electrical Cost Data for Change Orders 2013 Edition.

1.8 DEFINITIONS

- A. Where instructions are given in these specifications, such as "Provide the outlets...," the intent and meaning is the same as though the words "The Contractor shall" and carry the same meaning as "furnish and install, complete with all accessories and controls." Where "or equal" is used, it shall mean "or accepted equal" as determined by the Engineer.
- PART 2 PRODUCTS NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

BASIC ELECTRICAL REQUIREMENTS

SHORT-CIRCUIT COORDINATION STUDY

PART 1 - GENERAL

1.1 SCOPE

- A. The studies shall be submitted to the Design Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Engineer may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.
- B. The studies shall include all portions of the electrical distribution system from the normal power source or sources down to and including the smallest adjustable trip circuit breaker in the distribution system. Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.
- C. The firm should be currently involved in high- and low-voltage power system evaluation. The study shall be performed, stamped and signed by a registered professional engineer. Credentials of the individual(s) performing the study and background of the firm shall be submitted to the Engineer for approval prior to start of the work. A minimum of five (5) years experience in power system analysis is required for the individual in charge of the project.
- D. The firm performing the study should demonstrate capability and experience to provide assistance during start up as required.

1.2 DATA COLLECTION FOR THE STUDY

- A. The Contractor shall provide the required data for preparation of the studies. The Engineer performing the system studies shall furnish the Contractor with a listing of the required data immediately after award of the contract.
- B. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacturing.

PART 2 - PRODUCTS

2.1 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION AND COORDINATION STUDY

A. The short-circuit study shall be performed with the aid of a digital computer program and shall be in accordance with the latest applicable IEEE and ANSI standards.

- B. In the short-circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, tabulations of calculation quantities and results, conclusions, and recommendations. Calculate short-circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, unit substation primary and secondary terminals, low-voltage switchgear lineup, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant overcurrent protective device locations throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor fault contribution, short circuit kVA, and symmetrical and asymmetrical fault currents.
- C. In the protective device coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line colorized diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
- D. Include on the curve sheets power company relay and fuse characteristics, medium-voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices. In addition, include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards. Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical fault current to which the device is exposed.
- E. Select each primary protective device required for a delta-wye connected transformer so that its characteristic or operating band is within the transformer characteristics, including a point equal to 58 percent of the ANSI withstand point to provide secondary line-to-ground fault protection. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16 percent current margin to provide proper coordination and protection in the event of secondary line-to-line faults. Separate medium-voltage relay characteristic curves from curves for other devices by at least a 0.4-second time margin.
- F. Include complete fault calculations as specified herein based on contract documents.
- G. Submit qualifications of individual(s) who will perform the work for approval prior to commencement of the studies. Provide studies in conjunction with equipment submittals to verify equipment ratings required. Submit the study to Engineer for review prior to delivery of the study to the Owner. Make all additions or changes as required by the reviewer.
- H. Contractor shall furnish all data as required by the short-circuit/coordination study vendor. Utilize data for the study obtained by the Contractor from contract documents, including contract addendums issued prior to bid openings.
- I. Notify the Engineer in writing of circuit protective devices not properly rated for fault conditions.
- J. Mechanical Contractor to provide settings for the packaged chiller and/or motor starters.

K. When emergency generator is provided, include phase and ground coordination of the generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Contractor shall obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.

2.2 STUDY REPORT

- A. The results of the power system study shall be summarized in a final report. Six (6) bound copies of the final report shall be submitted.
- B. The report shall include the following sections:
 - 1. Descriptions, purpose, basis, and scope of the study
 - 2. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties, and commentary regarding same
 - 3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same
 - 4. Fault current calculations including a definition of terms and guide for interpretation of computer printout.

PART 3 - EXECUTION

3.1 POWER COMPANY APPROVAL

A. Where required, copies of the final report shall be submitted to the power company for their review and approval. Approved copies of the report shall be submitted to the Design Engineer.

3.2 FIELD SETTINGS

- A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study, and protective device coordination study.
- B. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short-circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the Owner.

END OF SECTION

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding electrodes and conductors; equipment grounding conductors; exothermic connectors; bonding methods and materials.
- B. Related Sections:
 - 1. Section 03300 Concrete Work.

1.2 REFERENCES

- A. NECA Standard of Installation.
- B. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. NFPA 70 National Electrical Code 2011 ed.
- D. IEEE 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems.

1.3 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Metal frame of the building.
 - 2. Concrete-encased electrode.
 - 3. Rod electrode.
 - 4. Metal underground water pipe.

1.4 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms.
- B. Section 01300 Submittals.
- C. Product Data: Submit grounding electrodes, connections and ground grid.
- D. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- E. Manufacturer's Installation Instructions: Submit for active electrodes.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01701 Contract Closeout Procedures.
- B. Section 01720 Project Record Documents.
 - C. Project Record Documents: Accurately record actual locations of components and grounding electrodes

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriter's Laboratories, Inc. as suitable for purpose specified and shown.

1.8 COORDINATION

- A. Section 01040 Coordination.
- B. Verify field measurements prior to fabrication.
- C. Complete grounding and bonding of building reinforcing steel prior to concrete placement.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES

- A. Material: Copper clad steel.
- B. Diameter: 3/4 inch.
- C. Length: 10 feet.

2.2 MECHANICAL CONNECTORS

- A. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.
- B. UL approved for use on ground systems.
- C. Not acceptable for use underground.

2.3 EXOTHERMIC CONNECTIONS

- A. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.
- B. Cadweld.
- C. ATI Tectoniks.

2.4 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: Sized per drawings.
- C. Grounding Electrode Conductor size to meet NFPA 70 requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01040 Coordination.
- B. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 EXISTING WORK

- A. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.
- B. Modify existing grounding system to maintain continuity to accommodate renovations.
- C. Extend existing grounding system using materials and methods as specified.

3.3 INSTALLATION

- A. Section 01400 Quality Control.
- B. Section 01600 Material and Equipment
- C. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- D. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing. Bond steel together. Sized per drawings or install 2/0 AWG bare copper in foundation footing.
- E. Provide bonding to meet Regulatory Requirements. Bond all insulated fitting of water piping system.
- F. Bond together metal siding not attached to grounded structure; bond to ground.
- G. Bond together reinforcing steel and metal accessories in structures.
- H. Bond together each metallic raceway, pipe, duct and other metal object entering space.
- I. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- J. Connect building steel to ground system with exothermic connectors.
- K. Mount a 4/0 ground wire on interior of each electrical room, data room and phone room 6" above floor level around perimeter of room and connect to ground system wire to serve as visual and easily assessable ground.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

L. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, light poles, flag poles, and other exposed non-current carrying metal parts of electrical equipment.

3.4 FIELD QUALITY CONTROL

- A. Section 01400 Quality Control.
- B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instruments manufacturer's recommendations using the full-of-potential method. Grid shall be measured at a minimum of 6 locations around the exterior of the building.

END OF SECTION

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1- GENERAL

- 1.1 SECTION INCLUDES
 - A. Conduit and equipment supports.
 - B. Anchors and fasteners.

1.2 REFERENCES

- A. NECA National Contractors Association.
- B. ANSI/NFPA 70 National Electrical Code 2011 ed.

1.3 QUALITY ASSURANCE

- A. Perform work in accordance with NECA Standard of Installation.
- B. Maintain one copy of each reference document on site.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 PRODUCTS

- 2.1 PRODUCT REQUIREMENTS
 - A. Materials and Finishes: Provide adequate corrosion resistance.
 - B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
 - C. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Use precast insert system, expansion anchors, and preset inserts.
 - 2. Steel Structural Elements: Use beam clamps.
 - 3. Concrete Surfaces: Use self-drilling anchors and expansion anchors.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.
 - 5. Solid Masonry Walls: Use expansion anchors and preset inserts.
 - 6. Sheet Metal: Use sheet metal screws.
 - 7. Wood Elements: Use wood screws.

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- C. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- D. Do not use spring steel clips and clamps.
- E. Do not use powder-actuated anchors.
- F. Do not drill or cut structural members.
- G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- H. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- I. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch (25 mm) off wall.
- J. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- K. Provide seismic supports for all electrical equipment, light fixtures, etc. to resist earthquake loads. Supports shall limit seismic acceleration to 1 g.

END OF SECTION
SECTION 16075

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Conduit markers.

1.2 RELATED SECTIONS

A. Section 09900 - Painting.

1.3 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with NECA Standard of Installation.
- B. Maintain one copy of each reference document on site.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.6 EXTRA MATERIALS

A. Furnish under provisions of General Requirements.

PART 2- PRODUCTS

2.1 NAMEPLATES AND LABELS

- A. Nameplates: Engraved three-layer laminated plastic, white letters on black background.
- B. Locations:
 - 1. Each electrical distribution and control equipment enclosure.
 - 2. Communication cabinets.

- C. Letter Size:
 - 1. Use 1/8 inch (3 mm)] letters for identifying individual equipment and loads.
 - 2. Use 1/4 inch (6 mm) letters for identifying grouped equipment and loads.
- D. Labels: Brother TZ series self-adhesive tape with 3/16" black letters on clear background.

2.2 WIRE MARKERS

- A. Description: Split sleeve, heat shrinkable or tubing type wire markers.
- B. Locations: Each conductor and low voltage cable at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
- C. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
 - 2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on drawings.
 - 3. Communication Cables: Run destination of each cable and/or pair.
 - 4. Medium Voltage Cable: Mark at each end with run destination and phasing.

D. Color:

- 1. 480 Volt System: Identified with brown, orange, yellow for phase A, B, C respectively.
- 2. 208 Volt System: Identified with black, red, blue for phase A, B, C respectively.
- 3. Neutral: White for 208 volt system, grey for 480 volt system.
- 4. Ground: Green for normal ground. Green with orange strip for isolated ground.

2.3 UNDERGROUND WARNING TAPE

A. Description: 3 inch (100 mm) wide plastic tape, detectable type, colored yellow with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

- A. Install nameplate and label parallel to equipment lines.
- B. Secure nameplate to equipment front using screws and rivets.
- C. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- D. Identify underground conduits using underground warning tape. Install one tape per trench at 12 inches above duct bank.
- E. Add embossed label at each receptacle and phone/data outlet with circuit number identified.
- F. Identify low voltage cables by room number or by shop drawing cable number at each end.

END OF SECTION

IDENTIFICATION FOR ELECTRICAL SYSTEMS

SECTION 16080

ELECTRICAL TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-16 sections apply to work of this section.

1.2 WORK INCLUDED

- A. Extent of testing required by this section is indicated on drawings and schedules, and by requirements of this section; and is defined to include, but is not necessarily limited to, electrical equipment and cables.
- B. Component types of testing specified in this section includes the following as applied to electrical equipment:
 - 1. Switchgear General
 - 2. Cables Low Voltage
 - 3. Grounding System
 - 4. Automatic Transfer
 - 5. Generator
 - 6. System Function Tests

1.3 QUALITY ASSURANCE

- A. Tester's Qualifications: Firm certified by National Electrical Testing Association (NETA) in those testing disciplines similar to those required for this project, who is not Installer of system to be tested and is otherwise independent of project.
- B. All inspections and tests shall be in accordance with the following applicable codes and standards except as provided otherwise herein.
 - 1. National Electrical Code NEC
 - 2. National Electrical Manufacturers Association NEMA
 - 3. American Society for Testing and Materials ASTM
 - 4. Institute of Electrical and Electronic Engineers IEEE
 - 5. National Electrical Testing Association NETA
 - 6. American National Standards Institute ANSI
 - 7. State and Local Codes and Ordinances
 - 8. Insulated Cable Engineers Association ICEA
 - 9. Association of Edison Illuminating Companies AEIC
 - 10. OSHA Part 1910; Subpart S, 1910.308
 - 11. National Fire Protection Association NFPA
- C. Inspections and tests shall utilize the following references.
 - 1. Project Design Specifications
 - 2. Project Design Drawings
 - 3. Manufacturer's instruction manuals applicable to each particular apparatus.

1.4 SUBMITTALS

A. Submit – Schedule of Completion.

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- B. Submit certified test reports, signed by Supervisor who performed work.
- C. Include identification and types of instruments used, and their most recent calibration date with submission of final test report.
- D. Submit biographical data on Supervisor who is to directly supervise testing, adjusting, and balancing work.

1.5 PROJECT/SITE CONDITIONS

- A. Do not proceed with testing until work pertaining to the specific test has been completed. Ensure that there is no latent residual work still to be completed.
- B. Do not proceed until work scheduled for testing and adjusting is clean and free from debris, dirt, and discarded building materials.

1.6 RESPONSIBILITY

- A. The contractor shall perform routine installation resistance, continually and rotation tests for all distribution and utilization equipment prior and in addition to tests performed by the testing laboratory specified herein.
- B. The contractor shall supply a suitable and stable source of test power to test laboratory at each test site. The testing laboratory shall specify requirements.
- C. The contractor shall notify the testing laboratory when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.
- D. The contractor shall supply a complete set of electrical plans, specifications and any pertinent change orders to the testing laboratory prior to commencement of testing.
- E. The testing laboratory shall notify the Architect/Engineer prior to commencement of any testing.
- F. The testing laboratory shall be responsible for implementing all final settings and adjustments on protective devices and tap changers in accordance with engineer's specified values.
- G. Any system material or workmanship which is found defective on the basis of acceptance tests shall be reported directly to the engineer.
- H. The testing laboratory shall maintain a written record of all tests and upon completion of project, assemble and certify a final test report.

PART 2 - PRODUCTS

2.1 TEST INSTRUMENTS

- A. Utilize test instruments and equipment for work required, of type, precision, and capacity as recommended in the following standards:
 - 1. NETA's Acceptance Testing Standards for Electrical Power Distribution Equipment and Systems.
 - 2. Test Instrument Traceability
 - a. The laboratory shall have a calibration program which maintains all applicable test instrumentation within rated accuracy.
 - b. The accuracy shall be traceable to the National Bureau of Standards in an unbroken chain.

- c. Instruments shall be calibrated in accordance with the following frequency schedule:
 - 1) Field Instruments 6 months maximum.
 - 2) Laboratory instruments 12 months.
 - 3) Leased specialty equipment 12 months
- d. Dated calibration labels shall be visible on all test equipment.
- e. Records must be kept up-to-date which show date and results of all instruments calibrated or tested.
- f. An up-to date instrument calibration instruction and procedure will be maintained for each test instrument.

PART 3 - EXECUTION

3.1 SUBMITTALS

A. Division 16 shall provide submittal documentation relative to commissioning to the CxA as requested by the CxA. Refer to Section 01330 for additional Division 16 requirements.

3.2 SYSTEM STARTUP

- A. The electrical contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 01330. Division 16 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or Owner.
- B. All systems and system components shall be tested in presence of commissioning Authority (and the Engineer if desired by the Engineer) to demonstrate compliance with specified requirements. To minimize the time of commissioning, contracting and engineering team members, testing shall be done in seasonal single blocks of time insofar as possible.
- C. The Contractor shall notify the Commissioning Authority fourteen (14) days prior to schedule. Functional Performance Tests, of the scheduled completion date of the Installation Verification and Pre-functional Testing.
- D. All testing shall be conducted under specified design operating conditions as approved by Commissioning Authority and Engineer.
- E. All elements of systems shall be tested to demonstrate that total systems satisfy all requirements of these Specifications. Testing shall be accomplished on hierarchical basis. Test each piece of equipment for proper operation, followed by each subsystem, followed by entire system, followed by any inter-ties to other major systems.
- F. All special testing materials and equipment shall be provided by Contractor.

3.3 FUNCTIONAL PERFORMANCE TESTS

- Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems, or sub-systems at the discretion of the CxA and CM. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all prefunctional checklists as soon as possible.
- B. Refer to Section 01330 for a list of systems to be commissioned and for a description of the process for specific details on the required functional performance tests.

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3.4 TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

- A. Provide one copy of all test reports and records to Commissioning Authority.
- B. Refer to Section 01330 for specific details on non-conformance issues relating to prefunctional checklists and tests.
- C. Refer to Section 01330 for issues relating to functional performance tests.
- D. Within sixty (60) days prior to startup of the Electrical system, the Commissioning Authority shall prepare and submit to the Owners Representative and Engineer for review, descriptions of the test procedures which the Contractor will perform to demonstrate conformance of completed Electrical systems to the Plans and Specifications.
- E. The decision of the Commissioning Authority and Engineer upon acceptability of test procedures shall be final. In the event of irresolvable conflict between decision of Commissioning Authority and Engineer, Engineer's decision shall be precedence. However, in no case shall such decision excuse the Contractor from fulfilling the requirements of commissioning as described in this section.
- F. Track commissioning deficiencies until corrected. Within each system, include one recommissioning for any deficiencies. Additional re-commissioning time beyond this will be tracked and billed at the hourly rates.

3.5 INSPECTION AND TEST PROCEDURES

1.

- A. Switchgear and Switchboard Assemblies
 - Visual and Mechanical Inspection
 - a. Inspect for physical damage.
 - b. Compare equipment nameplate information with latest single line diagram and report discrepancies.
 - c. Check tightness of accessible bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instruction for proper foot pound levels. In the absence of specific instructions use NETA Standards.
 - d. Key interlock systems shall be physically tested to insure proper function.
 - 1) Closure attempt shall be made on locked open devices.
 - 2) Opening attempt shall be made on locked closed devices.
 - 3) Key exchange shall be made with devices operated in off-normal positions.
 - e. All doors, panels and sections shall be inspected for pain, dents, scratches and fit.
 - 2. Electrical Tests
 - a. Insulation Resistance Test
 - 1) Measure insulation resistance of each bus section phase to ground.
 - Potential application shall be for one (1) minute. Test voltage shall be in accordance with NETA Standards or manufacturer's recommendations.
 - b. Overpotential Test
 - 1) Perform overpotential test on each bus section phase to ground.
 - 2) Potential application shall be for one (1) minute. Test voltage shall be in accordance with NETA Standards or manufacturer's recommendations.
 - c. Test Values
 - 1) Bolt torque levels shall be in accordance with manufacturer's recommendations.

 Insulation resistance test to be performed in accordance with Table A. Table A Insulation Resistance Test Voltage

Voltage Rating	Test Voltage
150 – 600V	1000V DČ
601 – 5000V	2500V DC
5001 -	5000V DC

- d. Values of insulation resistance less that manufacturer's minimum of KV +1 in megohms should be investigated. Overpotential tests should not proceed until insulation resistance levels are raised to said minimum.
- e. Overpotential test voltages shall be applied in accordance with ANSI 37.20c.
- B. Panelboards
 - 1. Visual and Mechanical Inspection
 - a. Compare equipment nameplate data with drawings and specifications.
 - b. Panelboards installed are in accordance with approved submittals and drawings.
 - c. Inspect physical and mechanical condition for damage, defects, etc.
 - d. Verify appropriate anchorage, fastening required clearances, physical damage, and correct alignment.
 - e. Panelboards are MLO and MCB as indicated on drawings.
 - f. Panelboards are fully-rated.
 - g. 200% neutrals provided where indicated in contract drawings.
 - h. Circuiting is as shown in contract documents.
 - i. Proper phasing maintained for multi-wire branch circuits.
 - j. Breaker AIC ratings are as shown on drawings.
 - k. Inspect all doors, panels, and sections for corrosion, dents, scratches, fit and missing hardware.
 - I. Verify that circuit-breaker sizes and types correspond to drawings and coordination study. Provide a copy of the completed, typed panelboard directory to accompany this completed report.
 - m. Breaker/wiring ampacities verified for compatibility.
 - n. Feeder connections torque per manufacturer requirements.
 - o. Breaker connections were torque per manufacturer requirements.
 - p. Inspect all bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low resistance ohmmeter in accordance with NETA Section 7.1.2 (Electrical Tests).
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench in accordance with manufacturer's published data or NETA Table 10.12.
 - q. Panelboards installed plumb, square and level.
 - r. Homeruns are per requirements of contract documents. Circuits were not combined.
 - s. Proper clearances verified in accordance with applicable National Electrical Code requirements.
 - t. Installed 6 ft. to top of panelboard, install panelboards taller than 6 ft. with bottom no more than 4 inches above floor.
 - u. Provide filler plates for unused openings.
 - v. Installation is in accordance with National Electrical Code.
 - w. Provide engraved plastic nameplates in accordance with specifications.
 - 2. Electrical Test
 - a. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20% of each other. Maintain proper phasing for multi-wire branch circuits.

C. Transformers

1.

- Visual and Mechanical Inspection
 - a. Inspect for physical damage.
 - b. Compare equipment nameplate information with latest single line diagram and report discrepancies.
 - c. Check tightness of accessible bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instruction for proper foot pound levels. In the absence of specific instructions use NETA Standards.
 - d. Verify location and clearance in accordance with specifications and applicable codes.
 - e. Verify that resilient mounts are free and all shipping brackets have been removed.
 - f. Verify that core, frame, and enclosure groundings are correct.
 - g. Verify that "as-left" tap connections are as specified.
 - h. Verify presence of electrostatic shield between primary and secondary windings.
 - i. Verify connections to transformer case are flexible type conduit and suitable for the location.
 - j. Seismic restraints provided.
- 2. Electrical Test
 - a. Perform insulation-resistance tests-winding to winding and each winding to ground with test voltage in accordance with NETA Table 10.5.
 - b. Perform an over potential test on all high and low-voltage windings to ground.
 - c. Verify correct secondary voltage phase to phase and phase to neutral after energization and prior to loading.
 - d. Measure grounding resistance at each transformer location.
 - e. Provide protection testing of each unit in accordance with NEMA ST 20.
- D. Cables Low Voltage (600 Volts And Less)
 - 1. Visual and Mechanical Inspection
 - a. Cables to be inspected for physical damage and proper connection in accordance with single line diagram.
 - b. Cable connection shall be torque tested to manufacturer's recommended values.
 - 2. Electrical Tests
 - a. Perform insulation resistance test on each cable with respect to ground and adjacent cables.
 - b. Perform continuity test to insure proper cable connection.
 - 3. Test Values
 - a. Insulation resistance tests shall be performed at 1000 volts D.C. for one-half (1/2) minute.
 - b. When insulation resistance must be determined with all switchboards, panelboards, fuse holders, switches, and overcurrent devices in place, the insulation resistance when tested at 500 volts D.C. shall be no less than below:

MINIMUM INSUALTION RESISTANCE

Conductor or Minimum	Conduit Size	Resistance
No. 14 and 12 AWG	1,000,000 ohms	
25 ampere circuits and above	250,000 ohms	

- E. Grounding Systems
 - Visual and Mechanical Inspection
 - a. Inspect ground system for compliance with plans and specifications.
 - 2. Electrical Tests

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1.

- a. Perform all of potential test per IEEE Standard No. 81, Section 9.04 on the main grounding electrode or system.
- b. Perform the two (2) point method test per IEEE Standards No. 81, Section 9.03 to determine the grounded resistance between the main grounding system and all major electrical equipment frames, system neutral and/or derived neutral points.
- 3. Alternate Method:
 - a. Perform ground continuity test between main gourd system and equipment frame, system neutral and/or derived neutral point. This test shall be made by passing a minimum of ten (10) amperes D.C. current between ground reference system and the ground point to be tested. Voltage drop shall be measured and resistance calculated by voltage drop method.
- 4. Test Values
 - a. The main ground electrode system resistance to ground should be no greater than five (5) ohms for commercial or industrial systems and one (1) ohm or less for generating or transmission station grounds unless otherwise specified by the engineer.
- F. Automatic Transfer Switches

1.

3.

- Visual and Mechanical Inspection
 - a. Inspect for physical damage.
 - b. Compare equipment nameplate information and connections with single line diagram and report and discrepancies.
 - c. Check switch to insure positive interlock between normal and alternate sources.
 - d. Check tightness of all cable connections and bus joints.
 - e. Perform manual transfer operation.
- 2. Electrical Tests
 - a. Perform insulation resistance tests phase to phase and phase to ground with switch in both source positions.
 - Set and calibrate in accordance with the specifications.
 - a. Voltage sensing relays.
 - b. Transfer time delay relay.
 - c. Engine shutdown relay.
- 4. Perform automatic transfer by:
 - a. Simulating loss of normal power.
 - b. Return to normal power.
- 5. Monitor and verify correct operation and timing:
 - a. Normal voltage sensing relays.
 - b. Engine start sequence.
 - c. Time delay upon transfer.
 - d. Alternate voltage sensing relays.
 - e. Automatic transfer operation.
 - f. Interlocks and limit switch function.
 - g. Timing delay and retransfer upon normal power restoration.
 - h. Engine shutdown feature.
- G. Engine Generator
 - 1. Visual and Mechanical Inspection
 - a. Inspect for physical damage.
 - b. Compare nameplate rating and connection with specifications and single line diagram.
 - Kw rating
 - c. Inspect for proper anchorage and grounding. Engine cooling and fuel system integrity shall be verified.
 - 2. Electrical Tests
 - a. A dielectric absorption test shall be made on generator winding with respect to ground. A polarization index shall be determined.

- b. Phase rotation test shall be made to determine compatibility with load requirements.
- c. Protective relay devices shall be tested in accordance with applicable sections of these specifications.
- d. Engine shutdown features shall be function tested:
 - 1) Low oil pressure.
 - 2) Over-temperature.
 - 3) Over-speed.
 - 4) Other features as applicable.
- e. Perform vibration base line test. Amplitude vs. frequency to be plotted for each main bearing cap.
- f. Perform resistive load bank test at one hundred percent (100%) nameplate rating. Loading shall be:
 - 1) 25% rated for 30 minutes.
 - 2) 50% rated for 30 minutes.
 - 3) 75% rated for 30 minutes.
 - 4) 100% rated for 3 hours.
- g. Record voltage, frequency, load, current, oil pressure and coolant temperature during test. Voltage regulation, frequency stability and maximum temperature rise shall be calculated.
- h. Perform overpotential test between winding to ground.
- 3. Test Values
 - Dielectric absorption test shall be made at test voltages listed in Table A.
 Polarization index shall be made for ten (10) minute durations. Readings less than three (3) shall be investigated. Vibration levels shall not exceed those listed in NEMA Standard 7-16-1969 thousand (1000) volts. Evaluation is go no-go basis.
 - b. Load test results shall be in accordance with manufacturer's specifications.
- H. Lighting Time Clock
 - 1. Visual and Mechanical Inspection
 - a. Lighting relay panels are installed in proper locations.
 - b. Inspect for physical damage.
 - c. Refer to Section 305 B Panelboards.
 - 2. Electrical Test
 - a. Exterior building lights turn on at sunset and off at sunrise.
 - b. Parking Lot lights on at sunset and off at 11:00pm.
- I. System Function Tests

1.

- General
 - a. Each system specified shall be function tested to insure total system operation.
 - b. Upon completion of equipment tests, the system function tests shall be
 - performed. It is the action devices to affect the design end product or result.
 - c. Implementation
 - The testing laboratory shall develop a test matrix which consists of: Input signal or stimuli. Example: Current Transformers. Potential Transformers.

Design process. Example: Pilot Wire Relay System.

Action device. Example: Circuit Breaker- OCB.

End product or result. Example: Zone Fault Protection.

- d. All interlock safety devices and fail safe functions shall be tested in addition to design function.
- e. The testing laboratory shall propose methods to initiate the sensing device by physical stimuli and quantitatively monitor the end result or output by measurement.
- 2. Prepare report of recommendation for correcting unsatisfactory electrical performances.

3.6 OPERATIONS AND MAINTENANCE (O&M) MANUALS

A. Division 16 shall compile and prepare documentation for all equipment and systems covered in Division 16 and deliver to the GC for inclusion in the O&M manuals, according to Division 1.

3.7 TRAINING OF OWNER PERSONNEL

- A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. Refer to Section 01330 for additional details.
- B. <u>Electrical Contractor</u>. The electrical contractor shall have the following training responsibilities:
 - 1. Provide the CxA with a training plan two weeks before the planned training according to the outline described in Section 01330.
 - 2. Provide designated Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.
 - 3. Training shall start with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
 - 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.
 - 6. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
 - 7. Training shall include:
 - a. Use the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
 - c. Discuss relevant health and safety issues and concerns.
 - d. Discuss warranties and guarantees.
 - e. Cover common troubleshooting problems and solutions.
 - f. Explain information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discuss any peculiarities of equipment installation or operation.
 - h. The format and training agenda in *Guidelines for Commissioning HVAC Systems*, ASHRAE, 1989R, 1996 is recommended.
 - i. Classroom sessions shall include the use of overhead projections, slides, video and audio taped material as might be appropriate.

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- 8. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.
- 9. The electrical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not *controlled* by the central control system.
- 10. Training shall occur after functional testing is complete, unless approved otherwise by the Project Manager.
- 11. Duration of Training: The electrical contractor shall provide training on each piece of equipment according to the following schedule or as specified in the associated specification section, whichever is greater.
 - a. <u>40</u> Fire Alarm System
 - b. <u>16</u> Lighting Controls
 - c. <u>40</u> Emergency Generator
 - d. <u>40</u> Security System
 - e. <u>16</u> Telecom and Data
 - f. <u>8</u> Variable Frequency Drive (VFD)

3.8 DEFERRED TESTING

A. Refer to Section 01330 for requirements of deferred testing.

3.9 WRITTEN WORK PRODUCTS

- A. Written work products of Contractors will consist of the startup and initial checkout plan described in Section 01330 and the filled out startup, initial checkout and prefunctional checklists.
- B. Interium testing reports shall be submitted to CxA for review within 7 days of respective activities.
- C. Submit final reports to CxA for review and approval within 7 days of completion of work. This shall take place at least 60 days prior to substantial completion.

END OF SECTION

SECTION 16095

MINOR ELECTRICAL DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
 - 2. Disposal of materials.
 - 3. Storage of removed materials.
 - 4. Identification of utilities.
 - 5. Salvaged items.
 - 6. Protection of items to remain [as scheduled at end of section] [as indicated on Drawings].
 - 7. Relocate existing equipment to accommodate construction.
- B. Related Sections:
 - 1. Section 02221 Building Demolition: Demolition of utilities and other underground items.
 - 2. Section 02225 Minor Demolition For Remodeling: Removal of designated building equipment and construction.
 - 3. Section 08310 Access Doors and Panels: Execution requirements for access doors and panels specified by this section.

1.2 SUBMITTALS

- A. Section 01330 Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate [demolition] [and] [removal sequence and location of salvageable items]; location and construction of temporary work. Describe demolition removal procedures and schedule.
- 1.3 CLOSEOUT SUBMITTALS
 - A. Section 01700 Execution Requirements: Requirements for submittals.
 - B. Project Record Documents: Record actual locations of capped utilities, conduits and equipment abandoned in place.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with State, Municipality of Clark County, and Public Work's standard.
- 1.5 PRE-INSTALLATION MEETINGS
 - A. Section 01310 Project Management and Coordination: Pre-installation meeting.
 - B. Convene minimum one week prior to commencing work of this section.

1.6 SEQUENCING

- A. Section 01100 Summary: Requirements for sequencing.
- B. Sequence work in the following order:
 - 1. Sequence will be based on construction phases identified by owner/owner representative.

1.7 SCHEDULING

- A. Section 01300 Administrative Requirements 01323 Network Analysis Schedules: Requirements for scheduling.
- B. Schedule work to coincide with new construction.
- C. Perform noisy, malodorous, dusty, or work:
 1. As identified in the Section 01300 Administrative Requirements.
- D. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.

1.8 COORDINATION

- A. Section 01300 Administrative Requirements: Requirements for coordination.
- B. Conduct demolition to minimize interference with adjacent and occupied building areas.
- C. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.
- D. Shut-down Periods:
 - 1. Arrange timing of shut-down periods of in service panels with Owner. Do not shut down any utility without prior written approval.
 - 2. Keep shut-down period to minimum or use intermittent period as directed by Owner.
 - 3. Maintain life-safety systems in full operation in occupied facilities, or provide notice minimum 3 working days in advance.
- E. Identify salvage items in cooperation with Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
- B. Verify termination points for demolished services.

3.2 PREPARATION

A. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Owner, Contractor's employees, and existing

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improvements to remain.

B. Temporary egress signage and emergency lighting

3.3 DEMOLITION

- A. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.
- B. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces to new or Owner's approval.
- C. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation.
- D. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- E. Reconnect equipment being disturbed by renovation work and required for continue service to back nearest connection or nearest available panel.
- F. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project.
- G. Install temporary wiring and connections to maintain existing systems in service during construction.
- H. Perform work on energized equipment or circuits with experienced and trained personnel.
- I. Remove, relocate, and extend existing installations to accommodate new construction.
- J. Repair adjacent construction and finishes damaged during demolition and extension work.
- K. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors.
- L. Clean and repair existing equipment to remain or to be reinstalled.
- M. Protect and retain power to existing active equipment remaining.
- N. Perform Work in accordance with State] Municipality of Clark County, Public Work's standards.

3.4 EXISTING PANELBOARDS

- A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Install new breakers.
- B. Tag unused circuits as spare.
- C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.
- D. Remove existing wire no longer in use from panel to equipment.

E. Provide new updated directories where more than three circuits have been modified or rewired.

3.5 SALVAGE ITEMS

- A. Remove and protect items indicated on Drawings, in Schedule to be salvaged and turn over to as described in the general requirements.
- B. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed.

3.6 REUSABLE ELECTRICAL EQUIPMENT

- A. Carefully remove equipment, materials, or fixtures which are to be reused.
- B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.
- C. Relocate existing lighting fixtures as indicated on Drawings. Clean fixtures and re-lamp. Test fixture to see if it is in good working condition before installation at new location.

3.7 CLEANING

- A. Section 01700 Execution Requirements: Requirements for cleaning.
- B. Remove demolished materials as work progresses. Legally dispose.
- C. Keep workplace neat.

3.8 PROTECTION OF FINISHED WORK

- A. Section 01700 Execution Requirements: Requirements for protecting finished Work.
- B. Do not permit traffic over unprotected floor surface].

END OF SECTION

SECTION 16095

SELECTIVE ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
 - 2. Disposal of materials.
 - 3. Storage of removed materials.
 - 4. Identification of utilities.
 - 5. Salvaged items.
 - 6. Protection of items to remain as indicated on Drawings.
 - 7. Relocate existing equipment to accommodate construction.
- B. Related Sections:
 - 1. Section 02 41 19 Selective Structure Demolition: Removal of designated building equipment and construction.

1.2 QUALITY ASSURANCE

A. Perform Work in accordance with State of Nevada Public Work's standard.

1.3 SCHEDULING

- A. Section 01300 Administrative Requirements: Requirements for scheduling.
- B. Schedule work to coincide with new construction.
- C. Perform noisy, malodorous, dusty, work: 1. As allowed by Owner.
- D. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.

1.4 COORDINATION

- A. Section 01300 Administrative Requirements: Requirements for coordination.
- B. Conduct demolition to minimize interference with adjacent occupied building areas.
- C. Coordinate demolition work with other trades.
- D. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.
- E. Shut-down Periods:
 - 1. Arrange timing of shut-down periods of in service panels with Owner. Do not shut down any utility without prior written approval.
 - 2. Keep shut-down period to minimum or use intermittent period as directed by Owner.

- 3. Maintain life-safety systems in full operation in occupied facilities, or provide notice minimum 3 days in advance.
- F. Identify salvage items in cooperation with Owner.
- PART 2 PRODUCTS Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01300 Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
- C. Verify termination points for demolished services.

3.2 PREPARATION

- A. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Owner, Contractor's employees, and existing improvements to remain.
- B. Temporary egress signage and emergency lighting

3.3 DEMOLITION

- A. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.
- B. Remove abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- C. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation.
- D. Disconnect electrical systems in walls, floors, and ceilings in areas of demolition.
- E. Reconnect equipment being disturbed by renovation work and required for continue service to nearest available panel.
- F. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project.
- G. Install temporary wiring and connections to maintain existing systems in service during construction.
- H. Perform work on energized equipment or circuits with experienced and trained personnel.
- I. Remove, relocate, and extend existing installations to accommodate new construction.

- J. Repair adjacent construction and finishes damaged during demolition and extension work.
- K. Remove abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors.
- L. Clean and repair existing equipment to remain or to be reinstalled.
- M. Protect and retain power to existing active equipment remaining.
- N. Cap abandoned empty conduit at both ends.
- O. Perform Work in accordance with State of Nevada Public Work's standards.

3.4 EXISTING PANELBOARDS

- A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Install new breakers.
- B. Tag unused circuits as spare.
- C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.
- D. Remove existing wire no longer in use from panel to equipment.
- E. Provide new updated typed directories where more than three circuits have been modified or rewired.

3.5 SALVAGE ITEMS

- A. Remove and protect items indicated on Drawings or otherwise directed by Owner to be salvaged and turn over to Owner.
- B. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed.

3.6 REUSABLE ELECTRICAL EQUIPMENT

- A. Carefully remove equipment, materials, or fixtures which are to be reused.
- B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.
- C. Relocate existing lighting fixtures as indicated on Drawings. Clean fixtures and re-lamp. Test fixture to see if it is in good working condition before installation at new location.

3.7 CLEANING

- A. Section 01700 Execution and Closeout Requirements: Requirements for cleaning.
- B. Remove demolished materials as work progresses. Legally dispose.
- C. Keep workplace neat.

3.8 PROTECTION OF FINISHED WORK

- A. Section 01700 Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Do not permit traffic over unprotected floor surface.

END OF SECTION

SECTION 16123

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes building wire and cable; metal clad cable; and wiring connectors and connections.
- B. Related Sections:
 - 1. Section 16075 Identification for Electrical Systems: Product requirements for wire identification.
 - 2. Section 31 23 17 Trenching: Execution requirements for trenching required by this section.
 - 3. Section 31 23 23 Fill: Requirements for backfill to be placed by this section.

1.2 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
 - 2. NFPA 262 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Underwriters Laboratories, Inc.:
 - 1. UL 1277 Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
 - 2. Stranded conductors for control circuits.
 - 3. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 4. Conductor not smaller than 14 AWG for control circuits.
 - 5. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet and shorter than 149 feet.
 - 6. 8 AWG conductors for 20 ampere, 120 volt branch circuits longer than 150 feet.
 - 7. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet and shorter than 329 feet.
 - 8. 8 AWG conductors for 20 ampere, 277 volt branch circuits longer than 330 feet.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Concealed Dry Interior Locations: Use only building wire, Type THW, THHN/THWN, XHHW insulation, in raceway or metal clad cable.
 - 2. Exposed Dry Interior Locations: Use only building wire, Type THW, THHN/THWN, XHHW insulation, in raceway or metal clad cable.
 - 3. Above Accessible Ceilings: Use only building wire, Type THW, THHN/THWN, XHHW insulation, in raceway, or metal clad cable.

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- 4. Wet or Damp Interior Locations: Use only building wire, Type THW, THHN/THWN, XHHW, insulation in raceway.
- 5. Exterior Locations: Use only building wire, Type THW, THHN/THWN, XHHW, insulation in raceway.
- 6. Underground Locations: Use only building wire, Type THW, THHN/THWN, XHHW, insulation in raceway.
- C. Metal Clad (MC) Cable may be used at the contractor's option for branch circuits between devices and for switching circuits. Exceptions to this are as follows:
 - 1. Circuit home runs shall be individual wires in approved raceways.
 - 2. Exposed wiring runs in unfinished spaces shall be individual wires in approved raceways.
 - 3. Type MC cable shall not be used for circuits crossing smoke/fire walls.
 - 4. Other restrictions as listed in the NEC and other applicable codes.

1.4 DESIGN REQUIREMENTS

- A. Conductor sizes are based on copper unless indicated as aluminum or "AL".
- B. When aluminum conductor is substituted for copper conductor, size to match circuit requirements for copper conductor ampacity and voltage drop.
- C. Aluminum conductors are not allowed on branch circuits.

1.5 SUBMITTALS

- A. See Division 1 for Submittal Procedures.
- B. Product Data: Submit for building wire and each cable assembly type.
- C. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.
- D. Test Reports: Indicate procedures and values obtained.

1.6 CLOSEOUT SUBMITTALS

- A. See Division 1 for Submittal Procedures for Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of components and circuits.

1.7 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.
- B. Perform Work in accordance with NECA's Standard of Installation and in accordance with recognized industry practices.
- 1.8 QUALIFICATIONS
 - A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.9 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on Drawings.

1.10 COORDINATION

- A. See Division 1 Administrative Requirements for Coordination and Project Conditions.
- B. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
- C. Wire and cable routing indicated is approximate unless dimensioned.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 - 1. Southwire Company.
 - 2. Okonite.
 - 3. Cable C.
 - 4. American Insulated Wire.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper for sizes smaller than 2 AWG; copper or aluminum for sizes 2 AWG and larger.
 - 1. Aluminum alloy conductors shall be compact stranded conductors of a recognized Aluminum Association 8000 Series aluminum alloy conductor material (AA-8000 series alloy).
 - 2. It is the responsibility of the contractor to increase the size of the conduit, wire gutter, or enclosure, if necessary, to accommodate the aluminum conductors and meet allowable code requirements.
 - 3. It is the responsibility of the contractor to increase the size of the aluminum conductor to match the ampacity of the copper conductor circuit shown on the Drawings.
 - 4. The contractor shall submit a feeder schedule to the Engineer for all conductor substitutions indicating the aluminum conductor wire size and the conduit size. The contractor shall not begin the installation until written approval is granted by the Engineer.
 - 5. All aluminum conductors shall terminate on a compression lug or compression adapter. An oxide-inhibiting joint compound must be applied on the aluminum conductor during termination. The compression connectors shall be installed according to manufacturers' instructions with the compression tool recommended by the manufacturer of the connector.
 - 6. The contractor shall perform an infrared survey of all aluminum conductor connections after the installation is complete and in normal service. Infrared surveys shall be performed during periods of maximum possible loading with at least 30% of rated load of the equipment being inspected. All connections with elevated temperatures shall be corrected by the contractor.
 - 7. No copper-to-aluminum transitions permitted when splicing onto existing copper feeders.
- D. Insulation: 600 volt rating; material rated 75 degrees C.

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E. Insulation Voltage Rating: 600 volts.

2.2 METAL CLAD CABLE

- A. Manufacturers:
 - 1. AFC Co.
 - 2. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Conductor: Copper minimum # 12 wire size.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 90 degrees C.
- E. Insulation Material: Thermoplastic.
- F. Armor Material: Steel.
- G. Armor Design: Corrugated tube with an overall mylar/polyproprolene tape covering the entire assembly.
- H. Grounding: Provide separate green insulated grounding conductor.

2.3 WIRING CONNECTORS

- A. Provide UL-type, factory-fabricated, metal connector taps or splices of sizes, ampacity ratings, materials, types and classes for applications and services indicated. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements, NEC and NEMA standards. Select from the following to fulfill project requirements:
 - 1. Split Bolt Connectors.
 - 2. Solderless Pressure Connectors.
 - 3. Spring Wire Connectors.
 - 4. Compression Connectors.

2.4 TERMINATIONS

- A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.
- B. Lugs for Wires 4 AWG and Larger. Color keyed, compression type copper, with insulating sealing collars.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. See Division 1 Administrative Requirements for Coordination and Project Conditions.
 - B. Verify interior of building has been protected from weather.
 - C. Verify mechanical work likely to damage wire and cable has been completed.
 - D. Verify raceway installation is complete and supported.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods as specified.
- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.4 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques-Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire 4 AWG and larger with pulling equipment.
- E. Special Techniques Cable:
 - 1. Protect exposed cable from damage.
 - 2. Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
 - 3. Use suitable cable fittings and connectors.
- F. Special Techniques Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. Each tap, joint, or splice in conductors No. 4 AWG and larger shall be taped with a minimum of two layers of rubber compound tape and three layers of vinyl plastic electrical tape and a finish wrap of color coding tape, where required by code. Insulation of splice shall match or exceed insulation level of conductors.
 - 4. Cable splices shall be made only in distribution and junction boxes.
 - 5. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturers published torque tightening requirements. If not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B.
 - 6. Splices shall not be made in feeders.
 - 7. Terminate aluminum conductors with tin-plated, aluminum-bodied compression connectors only. Fill with anti-oxidant compound before installing conductor.

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- 8. Install suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.
- G. Install solid conductor for feeders and branch circuits 10 AWG and smaller.
- Η. Use stranded conductor, No. 8 AWG and layer for general use wiring.
 - Use stranded conductor, No. 12 AWG and larger, for motors and other installations 1. where vibration is generated and for wiring to manufactured equipment.
 - Use stranded conductor. No. 14 AWG minimum for control wiring. 2
 - Install crimp on fork terminals for stranded conductor device terminations. Do not place 3. bare stranded conductors directly under screws.
- I. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.
- J. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2hole type lugs to connect wire 4 AWG and larger to copper bus bars.
- K. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

3.5 WIRE COLOR

- Α. General:
 - For wire sizes 10 AWG and smaller, install wire colors in accordance with the following: 1. Black and red for single phase circuits at 120/240 volts.
 - a. Black, red, and blue for circuits at 120/208 volts single or three phase. b.
 - C.
 - Brown, orange, and yellow for circuits at 277/480 volts single or three phase.
 - For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices 2. and boxes. Colors are as follows:
 - Black and red for single phase circuits at 120/240 volts. a.
 - Black, red, and blue for circuits at 120/208 volts single or three phase. b.
 - Brown, orange, and yellow for circuits at 277/480 volts single or three phase. C.
- Β. Neutral Conductors:
 - White for 120/208 and gray for 277/480 volt circuits. When two or more neutrals are 1. located in one conduit, individually identify each with proper circuit number.
 - Each circuit shall be provided with a dedicated neutral unless otherwise noted on the 2. drawings.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
 - For 6 AWG and smaller: Green. 1.
 - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.
 - 3. For isolated ground circuits: Green with yellow stripe.

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3.6 FIELD QUALITY CONTROL

- A. See Division 1 for Quality control requirements and for execution of Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION

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SECTION 16128

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.
- B. Related Sections:
 - 1. Section 16150 Wiring Connections.
 - 2. Section 16060 Grounding and Bonding for Electrical Systems.
 - 3. Section 16070 Hangers and Supports for Electrical Systems.
 - 4. Section 16141 Floor Boxes.
 - 5. Section 16133 Cable Trays for Electrical Systems.
 - 6. Section 16136 Underfloor Raceways Assemblies.
 - 7. Section 16075 Identification for Electrical Systems.
 - 8. Section 16131 Cabinets and Enclosures.
 - 9. Section 16132 Indoor Service Poles.
 - 10. Section 16140 Wiring Devices.
 - 11. Section 16129 Conduits and Backboxes for Communications Systems.
 - 12. Section 16133 Cable Trays for Communications Systems.
 - 13. Section 16130 Conduits and Backboxes for Electronic Safety and Security.
 - 14. Section 16134 Cable Trays for Electronic Safety and Security.
 - 15. Section 33 71 19 Electrical Underground Ducts and Manholes.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 Aluminum Rigid Conduit (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Underground: Provide thickwall nonmetallic conduit. Provide cast metal boxes or nonmetallic handhole.

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- C. In or Under Slab on Grade: Provide thickwall nonmetallic conduit. Provide cast or nonmetallic metal boxes.
- D. Outdoor Locations, Above Grade: Provide rigid steel and aluminum conduit, intermediate metal conduit and electrical metallic tubing. Provide cast metal or nonmetallic outlet, pull, and junction boxes.
- E. In Slab Above Grade: Provide rigid steel conduit, intermediate metal conduit and electrical metallic tubing. Provide sheet metal boxes.
- F. Wet and Damp Locations: Provide rigid steel and aluminum conduit, intermediate metal conduit and electrical metallic tubing. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
- G. Concealed Dry Locations: Provide rigid steel and aluminum conduit, intermediate metal conduit and, electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- H. Exposed Dry Locations: Provide rigid steel and aluminum conduit, intermediate metal conduit, and electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

1.4 DESIGN REQUIREMENTS

A. Minimum Raceway Size: 1/2 inch unless otherwise specified. All homeruns to panelboards shall be minimum size ³/₄ inch.

1.5 SUBMITTALS

- A. See Division 1 for Submittal Procedures.
- B. Product Data: Submit for the following:
 - 1. Flexible metal conduit.
 - 2. Liquidtight flexible metal conduit.
 - 3. Nonmetallic conduit.
 - 4. Flexible nonmetallic conduit.
 - 5. Raceway fittings.
 - 6. Conduit bodies.
 - 7. Surface raceway.
 - 8. Wireway.
 - 9. Pull and junction boxes.
 - 10. Handholes.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 CLOSEOUT SUBMITTALS

- A. See Division 1: Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents:
 - 1. Record actual routing of conduits larger than 2 inch.
 - 2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

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1.7 DELIVERY, STORAGE, AND HANDLING

- A. See Division 1: Product Requirements: Product storage and handling requirements.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

1.8 COORDINATION

- A. See Division 1: Administrative Requirements: Coordination and project conditions.
- B. Coordinate installation of outlet boxes for equipment connected under Section 16150.
- C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 - PRODUCTS

- 2.1 METAL CONDUIT
 - A. Rigid Steel Conduit: ANSI C80.1.
 - B. Rigid Aluminum Conduit: ANSI C80.5.
 - C. Intermediate Metal Conduit (IMC): Rigid steel.
 - D. Fittings and Conduit Bodies: NEMA FB 1; all steel fittings.
- 2.2 PVC COATED METAL CONDUIT
 - A. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil thick.
 - B. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.
- 2.3 FLEXIBLE METAL CONDUIT
 - A. Product Description: Interlocked steel construction.
 - B. Fittings: NEMA FB 1.
- 2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT
 - A. Product Description: Interlocked steel construction with PVC jacket.
 - B. Fittings: NEMA FB 1.
- 2.5 ELECTRICAL METALLIC TUBING (EMT)
 - A. Product Description: ANSI C80.3; galvanized tubing.
 - B. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, compression set screw type.

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2.6 NONMETALLIC CONDUIT

- A. Product Description: NEMA TC 2; Schedule 40 and 80 PVC.
- B. Fittings and Conduit Bodies: NEMA TC 3.

2.7 SURFACE METAL RACEWAY

- A. Manufacturers:
 - 1. Thomas & Betts Corp. Model SR600VCB.
 - 2. The Wiremold Co. Model V4000.
 - 3. Mono Systems.
 - 4. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.
- C. Size: As indicated on drawings.
- D. Finish: Ivory enamel.
- E. Fittings, Boxes, and Extension Rings: Furnish manufacturer's standard accessories; match finish on raceway.
- F. Receptacles: Provide only metallic device plates with overlap edges and accessories to accept convenience receptacles specified in Section 16141.
 - 1. Single Duplex #V4048B OL
 - 2. Duplex / Data #V4048BF OL
- G. Receptacle Color: Ivory.

2.8 WIREWAY

- A. Product Description: [General purpose] [Oiltight and dust-tight] [Raintight] type wireway.
- B. Knockouts: [Manufacturer's standard] [None] [Bottom only].
- C. Size: As indicated on Drawings.
- D. Cover: [Hinged] [Screw] cover [with full gaskets.]
- E. Connector: [Slip-in] [Flanged].
- F. Fittings: Lay-in type with removable top, bottom, and side; captive screws.
- G. Finish: Rust inhibiting primer coating with gray enamel finish.

2.9 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch (13 mm) male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- B. Nonmetallic Outlet Boxes: NEMA OS 2.

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- C. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.
- D. Wall Plates for Finished Areas: As specified in Section 16140.
- E. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.10 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 16131.
- C. Concrete composite Handholes: Concrete composite hand holes:
 - 1. Cable Entrance: Pre-cut 6 inch x 6 inch (150 mm x 150 mm) cable entrance at center bottom of each side.
 - 2. Cover: Concrete composite, weatherproof cover with nonskid finish.
 - 3. Cover Legend: "Electric".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. See Division 1 Administrative Requirements: Coordination and project conditions.
- B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 16060.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 16070.
- C. Identify raceway and boxes in accordance with Section 16075.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.

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E. Conceal raceway except in mechanical or utility areas and where noted exposed.

3.4 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wireway supports from steel channel specified in Section 16070.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- J. Route conduit in and under slab from point-to-point.
- K. Maximum Size Conduit in Slab Above Grade: 3/4 inch. Do not cross conduits in slab.
- L. Maintain clearance between raceway and piping for maintenance purposes.
- M. Maintain 12 inch (300 mm) clearance between raceway and surfaces with temperatures exceeding 104 degrees F (40 degrees C).
- N. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- O. Bring conduit to shoulder of fittings; fasten securely.
- P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- Q. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- R. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate or factory elbows for bends in metal conduit larger than 2 inch (50 mm) size.
- S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- T. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

- U. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- W. Close ends and unused openings in wireway.

3.5 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings and as specified in section for outlet device.
- B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 16140.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.
- F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches (150 mm) separation. Install with minimum 24 inches (600 mm) separation in acoustic rated walls.
- H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- I. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- K. Install adjustable steel channel fasteners for hung ceiling outlet box.
- L. Do not fasten boxes to ceiling support wires or other piping systems.
- M. Support boxes independently of conduit.
- N. Install gang box where more than one device is mounted together. Do not use sectional box.
- O. Install gang box with plaster ring for single device outlets.

3.6 SURFACE MOUNTED RACEWAY INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Use flat-head screws, clips, and straps to fasten raceway channel to surfaces. Mount plumb and level.
- C. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- D. Wireway Supports: Provide steel channel as specified in Section 16070.
- E. Close ends of wireway and unused conduit openings.

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

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- F. Ground and bond raceway and wireway under provisions of Section 16060.
- G. Mount at 30" to bottom from finished floor in all classrooms.
- H. All exposed conduit in occupied areas shall be surface mounted raceway.
- I. Use factory supplied tools for cutting of base and covers. Use Wiremold Catalog Number 640B for base cuts, Wiremold Catalog Number 640C for cover cuts, and Wiremold Catalog Number 605 for V500 raceway cuts. Do not use saw cuts for field cutting. Turn over tools to CCSD upon completion of project.

3.7 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Section 07840.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified in Section [_____].
- C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.8 ADJUSTING

- A. See Division 1 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused openings in boxes.

3.9 CLEANING

- A. See Division 1 Execution and Closeout Requirements: Final cleaning.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 16131

CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes hinged cover enclosures, cabinets, terminal blocks, and accessories.

1.2 REFERENCES

- A. NECA (National Electrical Contractors Association) -Standard of Installation.
- B. NEMA ICS 4 (National Electrical Manufacturers Association) Terminal Blocks for Industrial Control Equipment and Systems.
- C. NEMA 250 (National Electrical Manufacturers Association) Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

- A. Section 01300 Submittals.
- B. Product Data: Submit manufacturer's standard data for enclosures, cabinets, and terminal blocks.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.5 EXTRA MATERIALS

- A. Section 01750 Spare Parts and Maintenance Materials.
- B. Furnish two of each key.

PART 2 - PRODUCTS

- 2.1 HINGED COVER ENCLOSURES
 - A. Construction: NEMA 250, Type I steel enclosure (inside), Type 3R steel enclosure (outside).
 - B. Covers: Continuous hinge, held closed by flush latch operable by key.
- C. Furnish interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
- D. Enclosure Finish: Manufacturer's standard enamel.

2.2 CABINETS

- A. Boxes: Galvanized steel.
- B. Box Size: 24 inches wide x 36 inches high x 8 inches deep.
- C. Backboard: Furnish 3/4 inch thick plywood backboard for mounting terminal blocks. Paint matte white.
- D. Fronts: Steel, surface type with concealed trim clamps, door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
- E. Furnish metal barriers to form separate compartments wiring of different systems and voltages.
- F. Furnish accessory feet for free-standing equipment.

2.3 TERMINAL BLOCKS

- A. Terminal Blocks: NEMA ICS 4.
- B. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- C. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
- D. Furnish ground bus terminal block, with each connector bonded to enclosure.

2.4 PLASTIC RACEWAY

A. Product Description: Plastic channel with hinged or snap-on cover.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation."
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner in accordance with Section 16050.
- C. Install cabinet fronts plumb.

3.2 CLEANING

- A. Section 01710 Final cleaning.
- B. Clean electrical parts to remove conductive and harmful materials.

- C. Remove dirt and debris from enclosure.
- D. Clean finishes and touch up damage.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes wall switches; wall dimmers; receptacles; multioutlet assembly; and device plates and decorative box covers.
- B. Related Sections:
 - 1. Section 16128 Raceway and Boxes: Outlet boxes for wiring devices.

1.2 REFERENCES

- A. NECA (National Electrical Contractors Association) Standard of Installation.
- B. NEMA WD 1 (National Electrical Manufacturers Association) General Requirements for Wiring Devices.
- C. NEMA WD 6 (National Electrical Manufacturers Association) Wiring Device -- Dimensional Requirements.

1.3 SUBMITTALS

- A. Submit under provision of General Requirements.
- B. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.5 EXTRA MATERIALS

- A. Section 01750 Spare Parts and Maintenance Materials.
- B. Furnish two of each style, size, and finish wall plate.

PART 2 - PRODUCTS

- 2.1 WALL SWITCHES
 - A. Product Description: NEMA WD 1, Heavy-Duty, AC only, hard-use snap switch.
 - B. Body and Handle: White nylon with rocker handle.

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- C. Ratings:
 - 1. Voltage: 120-277 volts, AC.
 - 2. Current: 20 amperes.
- D. Equal to Pass and Seymour 26021-W.

2.2 RECEPTACLES

- A. Product Description: NEMA WD 1, Heavy-duty extra hard-use specification grade receptacle.
- B. Device Body: White nylon.
- C. Configuration: NEMA WD 6, type.
- D. Convenience Receptacle: Type 5-20, equal to Pass & Seymour 26362-W.
- E. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements. Equal to Pass & Seymour 2091-SHG-W.
- F. USB Charger/Duplex Tamper-Resistant Receptacle: Combination Duplex receptacle/Outlet and USB charger 20Amp 125 voltage NEMA 5-20R 3.6A Equal to Leviton T5832-*.
- G. Weather Proof Cover: NEMA 3R while in use Taymac specification grade or equal.

2.3 WALL PLATES

- A. Decorative Cover Plate: White nylon on gypboard walls, stainless steel on masonary walls, stainless steel on classroom walls, stainless steel on corridor and lobby walls.
- B. Jumbo Cover Plate: White nylon on gypboard walls, stainless steel on masonary walls.
- C. Weatherproof Cover Plate: NEMA 3R while in use Taymac specification grade or equal.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. Section 01040 Coordination.
 - B. Verify outlet boxes are installed at proper height.
 - C. Verify wall openings are neatly cut and completely covered by wall plates.
 - D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Clean debris from outlet boxes.

3.3 INSTALLATION

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- A. Install in accordance with NECA "Standard of Installation."
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- E. Do not share neutral conductor on load side of dimmers.
- F. Install receptacles with grounding pole down.
- G. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- H. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- I. Connect wiring devices by wrapping solid conductor around screw terminal.
- J. Use jumbo size plates for outlets installed in masonry walls.
- K. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- L. Install and wire 3 way switches so all switches are in down position when lights are off.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 16130 to obtain mounting heights as specified and as indicated on drawings.
- B. Install wall switch 48 inches above finished floor.
- C. Install convenience receptacle 18 inches above finished floor.
- D. Install convenience receptacle 6 inches above back splash of counter.
- E. Install dimmer 48 inches above finished floor.
- F. Coordinate installation of wiring devices with underfloor raceway service fittings provided under Section 16141.
- G. Coordinate installation of wiring devices with floor box service fittings provided under Section 16141.

3.5 FIELD QUALITY CONTROL

- A. Section 01400 Quality Control.
- B. Inspect each wiring device for defects.
- C. Operate each wall switch with circuit energized and verify proper operation.
- D. Verify each receptacle device is energized.

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- E. Test each receptacle device for proper polarity.
- F. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

- A. Section 01710 Final Cleaning.
- B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

WIRING DEVICES

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SECTION 16141

FLOOR BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes floor boxes; floor box service fittings; poke-through fittings; and access floor boxes.
- B. Related Sections:
 - 1. Section 16128 Raceway and Boxes.
 - 2. Section 16140 Wiring Devices.

1.2 REFERENCES

- A. NECA (National Electrical Contractors Association)- Standard of Installation.
- B. NEMA OS 1 (National Electrical Manufacturers Association) Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

1.3 SUBMITTALS

- A. Section 01300 Submittals.
- B. Product Data: Submit catalog data, including dimensions for floor boxes and service fittings.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01701 Contract Closeout Procedures.
- B. Project Record Documents: Record actual locations of each floor box.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 EXTRA MATERIALS

- A. Section 01750 Spare Parts and Maintenance Materials.
- B. Furnish four carpet rings and four tile rings.

PART 2 - PRODUCTS

2.1 FLOOR BOXES

- A. Manufacturers:
 - 1. Steel City, Model 667SC Series Concealed Floor Boxnsert.
 - 2. Substitutions: Section 01630.

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- B. Adjustability: Fully adjustable.
- C. Material: 14 gauge pre-galvanized steel.
- D. Shape: Hinged Rectangular.
- E. Top: Polyamide carpet/tile plate with retractable exit, dark grey color.
- F. Devices: Power as shown on drawings. Data provide blank for 4 modular jacks.

2.2 FLUSH FIRE-RATED POKE-THROUGH FOR POWER

- A. Manufacturers:
 - 1. Hubbell.
 - 2. Steel City.
 - 3. Wiremold/Walker
 - 4. Substitutions: Section 01630.
- B. Fire Rating: 1 hour.
- C. Conduit Size: ³/₄".
- D. Service Fitting: Flush brass with one (1) 20 amp duplex receptacle.

2.3 FLUSH FIRE-RATED POKE-THROUGH FOR DATA

- A. Manufacturers:
 - 1. Hubbell.
 - 2. Steel City.
 - 3. Wiremold/Walker
 - 4. Substitutions: Section 01630.
- B. Fire Rating: 1 hour.
- C. Conduit Size: 1-1/4".
- D. Service Fitting: Flush brass with four (4) modular jack openings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01040 Coordination.
- B. Verify locations of floor boxes and outlets in offices prior to rough-in.

3.2 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation."
- B. Boxes and fittings are indicated on Drawings in approximate locations unless dimensioned. Adjust box location up to 10 feet to accommodate intended purpose.

- C. Floor Box Requirements: Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.
- D. Set floor boxes level.
- E. Install protective rings on active flush cover service fittings.
- F. Use flush fire rated poke-through type floor boxes for existing upper floors or as indicated on drawings.
- 3.3 ADJUSTING
 - A. Section 01701 Contract Closeout Procedures.
 - B. Adjust floor box flush with finish flooring material.

3.4 CLEANING

- A. Section 01710 Final cleaning.
- B. Clean interior of boxes to remove dust, debris, and other material.

END OF SECTION

SECTION 16150

EQUIPMENT WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes electrical connections to equipment.
- B. Related Sections:
 - 1. Section 16123 Building Wire and Cable.
 - 2. Section 16128 Raceway and Boxes for Electrical Systems.

1.2 REFERENCES

- A. NEMA WD 1 (National Electrical Protection Association) General Purpose Wiring Devices.
- B. NEMA WD 6 (National Electrical Protection Association) Wiring Devices Dimensional Requirements.

1.3 SUBMITTALS

- A. Submit under provisions of General Conditions.
- B. Product Data: Submit wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01701 Contract Closeout Procedures.
- B. Project Record Documents: Record actual locations, sizes, and configurations of equipment connections.

1.5 COORDINATION

- A. Section 01040 Coordination.
- B. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and requirements.
- D. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- E. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 - PRODUCTS

2.1 CORD AND PLUGS

- A. Attachment Plug Construction: Conform to NEMA WD 1.
- B. Configuration: NEMA WD 6; match receptacle configuration at outlet furnished for equipment.
- C. Cord Construction: Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
- D. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01040 Coordination.
- B. Verify equipment is ready for electrical connection, for wiring, and to be energized.

3.2 INSTALLATION

- A. Make electrical connections.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations for vibration isolation for all equipment containing motors.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Install receptacle outlet to accommodate connection with attachment plug.
- E. Install cord and cap for field-supplied attachment plug.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.
- J. Install electrical wiring and conduit connections to furniture.
- K. Install communications conduit connections to furniture.

3.3 ADJUSTING

- A. Section 01650 Starting of Systems.
- B. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

END OF SECTION

EQUIPMENT WIRING CONNECTIONS

SECTION 16281

VOLTAGE REGULATORS (SURGE PROTECTIVE DEVICES (SPD's))

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as distribution switchboards and panelboards.

1.2 RELATED SECTIONS

- A. Section 16441 Switchboards.
- B. Section 16442 Panelboards.

1.3 REFERENCES

A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).

1.4 SUBMITTALS

- A. The following information shall be submitted to the Engineer for each Device:
 - 1. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NRTL's website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (I_n).
- B. Product Data: Submit capacity, dimensions, weights, details, and wiring configuration.
- C. Test Reports:
 - 1. Indicate Let-Through voltage test data.
 - 2. Submit spectrum analysis of each unit.
 - 3. Submit test reports from nationally recognized independent testing laboratory verifying suppressors can survive published surge current rating
- D. Manufacturer's Installation Instructions: Submit installation instructions and connection requirements.

1.5 CLOSEOUT SUBMITTALS

- A. The following information shall be submitted for record purposes:
 - 1. Final as-built drawings and information for items listed in Section 1.04 and shall incorporate all changes made during the manufacturing process.

1.6 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.
- 1.8 OPERATION AND MAINTENANCE MANUALS
 - A. Operation and maintenance manuals shall be provided with each SPD shipped.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
 - A. Eaton
 - B. General Electric
 - C. Square D
 - D. Siemens

Use only equipment from the above manufacturers.

2.2 VOLTAGE SURGE SUPPRESSION – GENERAL

- A. Electrical Requirements
 - 1. Unit Operating Voltage Refer to drawings for operating voltage and unit configuration.
 - 2. Maximum Continuous Operating Voltage (MCOV) The MCOV shall not be less than 125% of the nominal system operating voltage.
 - 3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A
Single Split Phase	•	•	•	•
High Leg Delta	•	•	•	•

- 5. Nominal Discharge Current (In) All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.
- 6. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700V	1200V	1500V
L-L	1200V	1800V	3000V

 ANSI/IEEE C High Let-Through Voltage – The let through voltage based on an ANSI/IEEE C62.41 Category C High waveform (10kV, 10kA) shall not exceed the following:

Mode	208Y/120	480Y/277	600Y/347
L-N	500	900	1300

 ANSI/IEEE Cat. B Ringwave Let Through Voltage – The let-through voltage based on an ANSI/IEEE C62.41 Category B ringwave (6 kV, 500 amps) shall not exceed the following:

Mode	208Y/120	480Y/277	600Y/347
L-N	170	300	470

SPD Design

Β.

- Maintenance Free Design The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
- 2. Balanced Suppression Platform The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
- 3. Electrical Noise Filter Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
- 4. Internal Connections No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors
- 5. Monitoring Diagnostics Each SPD shall provide the following integral monitoring options:
 - a. Protection Status Indicators Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
 - For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
 - 2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
 - 3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
 - b. Remote Status Monitor The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
 - c. Audible Alarm and Silence Button The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

- d. Surge Counter The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.
 - 1) The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.
- 6. Overcurrent Protection
 - a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
- 7. Fully Integrated Component Design All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
- 8. Safety Requirements

a.

- The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
- b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

2.3 SYSTEM APPLICATION

- A. The SPD applications covered under this section include distribution switchboard and panelboard location assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
- B. Surge Current Capacity The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category				
Category	Application	Per Phase	Per Mode	
с	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA	
В	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA	
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA	

C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.4 DISTRIBUTION SWITCHBOARD AND PANELBOARD REQUIREMENTS

- A. Panelboards
 - 1. The SPD application covered under this section includes Panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category A environments.
 - 2. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
 - 3. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
 - 4. The panelboard shall be capable of re-energizing upon removal of the SPD.
 - 5. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.
 - 6. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
 - 7. The SPD shall be of the same manufacturer as the panelboard.
 - 8. The complete panelboard including the SPD shall be UL67 listed.
- B. Distribution Switchboards
 - 1. The SPD application covered under this section includes Distribution Switchboards. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
 - 2. The SPD shall be of the same manufacturer as the switchboard.
 - 3. The SPD shall be factory installed inside the switchboard at the assembly point by the original equipment manufacturer
 - 4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
 - 5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
 - 6. The SPD shall be integral to switchboard as a factory standardized design.
 - 7. All monitoring and diagnostic features shall be visible from the front of the equipment.

VOLTAGE REGULATORS SPD

2.5 ENCLOSURES

- A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:
 - NEMA 1 Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
 - 2. NEMA 4 Constructed of steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure. (sidemount units only)
 - 3. NEMA 4X Constructed of stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection. (sidemount units only)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Division 1 Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify mounting area is ready for equipment.
- C. Verify circuit rough-ins are at correct location.

3.2 FACTORY TESTING

A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.3 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.

3.4 WARRANTY

A. The manufacturer shall provide a full ten (10) year warranty from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local code.

END OF SECTION

SECTION 16411

ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fusible and non-fusible switches.
- B. Related Sections:
 - 1. Section 16491 Fuses.

1.2 REFERENCES

- A. NECA (National Electrical Contractors Association) -Standard of Installation.
- B. NEMA FU1 (National Electrical Contractors Association).- Low Voltage Cartridge Fuses.
- C. NEMA KS 1 (National Electrical Contractors Association).- Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- D. NETA ATS (International Electrical Testing Association) Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).

1.3 SUBMITTALS

- A. 01300 Submittals.
- B. Product Data: Submit switch ratings and enclosure dimensions.
- 1.4 CLOSEOUT SUBMITTALS
 - A. Section 01701 Contract Closeout Procedures.
 - B. Section 01720 Project Record Documents.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 - PRODUCTS

- 2.1 FUSIBLE SWITCH ASSEMBLIES
 - A. Manufacturers:
 - 1. GE.
 - 2. Square D.
 - 3. Cutler Hammer.
 - 4. ITE / Siemens.

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- B. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.
- D. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.
- E. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- F. Furnish switches with entirely copper current carrying parts.

2.2 NONFUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. GE.
 - 2. Square D.
 - 3. Cutler Hammer.
 - 4. ITE / Siemens.
- B. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.
- D. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- E. Furnish switches with entirely copper current carrying parts.

2.3 SWITCH RATINGS

- A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
- B. Short Circuit Current Rating: UL listed for 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes).

PART 3 - EXECUTION

- 3.1 INSTALLATION
 - A. Install in accordance with NECA "Standard of Installation."
 - B. Install enclosed switches plumb. Provide supports in accordance with Section 16070.

ENCLOSED SWITCHES

- C. Height: 5 feet to operating handle.
- D. Install fuses for fusible disconnect switches. Refer to Section 16491 for product requirements.
- E. Install engraved plastic nameplates in accordance with Section 16075.
- F. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.
- 3.2 FIELD QUALITY CONTROL
 - A. Section 01400 Quality Control.
 - B. Inspect and test in accordance with NETA ATS, except Section 4.
 - C. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION

ENCLOSED SWITCHES

SECTION 16421

ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes manual and magnetic motor controllers in individual enclosures.
- B. Related Sections:
 - 1. Section 16491 Fuses.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA FU 1 Low Voltage Cartridge Fuses.
 - 3. NEMA ICS 2 Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 4. NEMA ICS 5 Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 5. NEMA ICS 6 Industrial Control and Systems: Enclosures.
 - 6. NEMA KS 1 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. See Division 1 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- C. Test Reports: Indicate field test and inspection procedures and test results.

1.4 CLOSEOUT SUBMITTALS

- A. See Division 1 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations and ratings of enclosed controllers.
- C. Operation and Maintenance Data: Submit Replacement parts list for controllers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years [documented] experience.

ENCLOSED CONTROLLERS

PART 2 - PRODUCTS

2.1 MANUAL MOTOR CONTROLLER

- A. Manufacturers:
 - 1. Square D.
 - 2. General Electric.
 - 3. Cutler Hammer.
 - 4. Allen Bradley.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, fullvoltage controller with overload element, red pilot light, NO, NC, field convertible auxiliary contact, and push button operator.
- C. Enclosure: NEMA ICS 6, Type [1] [3R] [4] [to meet conditions of installation].

2.2 FRACTIONAL-HORSEPOWER MANUAL CONTROLLER

- A. Manufacturers:
 - 1. Square D.
 - 2. General Electric.
 - 3. Cutler Hammer.
 - 4. Allen Bradley.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, fullvoltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light, and toggle operator.
- C. Enclosure: NEMA ICS 6, Type [1] [3R] [4] [to meet conditions of installation].

2.3 FULL-VOLTAGE NON-REVERSING CONTROLLERS

- A. Manufacturers:
 - 1. Square D.
 - 2. General Electric.
 - 3. Cutler Hammer.
 - 4. Allen Bradley.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA ICS 2, AC general-purpose Class A solid-state controller for induction motors rated in horsepower.
- C. Control Voltage: 120 volts, 60 Hertz.
- D. Overload Relay: NEMA ICS 2; melting alloy.
- E. Product Features:
 - 1. Auxiliary Contacts: NEMA ICS 2, 2 each field convertible contacts in addition to seal-in contact.
 - 2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oiltight type.
 - 3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
 - 4. Pushbuttons: Shrouded type.
 - 5. Indicating Lights: Transformer LED type.

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- 6. Selector Switches: Rotary type.
- 7. Relays: NEMA ICS 2.
- 8. Control Power Transformers: 120 volt secondary, 100 VA minimum, in each motor starter. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
- F. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole.

****** [OR] ******

G. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using motor circuit protector conforming to NEMA AB 1, with integral instantaneous magnetic trip in each pole. Obtain IEC Class 2 coordinated component protection.

****** [OR] ******

H. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using non-fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle.

****** [OR] ******

- I. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses. Obtain IEC Class 2 coordinated component protection.
- J. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type [3R] [4].
 - 3. [____] Locations: Type [____].

2.4 TWO-SPEED CONTROLLERS

- A. Manufacturers:
 - 1. General Electric.
 - 2. Square D.
 - 3. Cutler Hammer.
 - 4. Allen Bradley.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA ICS 2, AC general-purpose Class A solid-state controller for induction motors rated in horsepower. Include integral time delay transition between FAST and SLOW speeds.
- C. Control Voltage: 120 volts, 60 Hertz.
- D. Overload Relay: NEMA ICS 2; melting alloy.
- E. Product Features:
 - 1. Auxiliary Contacts: NEMA ICS 2, 2 each field convertible contacts in addition to seal-in contact.

- 2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oiltight type.
- 3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
- 4. Pushbuttons: Shrouded type.
- 5. Indicating Lights: Transformer LED type.
- 6. Selector Switches: Rotary type.
- 7. Relays: NEMA ICS 2.
- 8. Control Power Transformers: 120 volt secondary, 100 VA minimum, in each motor starter. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
- F. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole.

****** [OR] ******

G. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using motor circuit protector conforming to NEMA AB 1, with integral instantaneous magnetic trip in each pole. Obtain IEC Class 2 coordinated component protection.

****** [OR] ******

H. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using non-fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle.

****** [OR] ******

- I. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses. Obtain IEC Class 2 coordinated component protection.
- J. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type [3R] [4].
 - 3. [____] Locations: Type [____].
- 2.5 FULL-VOLTAGE REVERSING CONTROLLERS
 - A. Manufacturers:
 - 1. Square D.
 - 2. General Electric.
 - 3. Cutler Hammer.
 - 4. Allen Bradley.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
 - B. Product Description: NEMA ICS 2, AC general-purpose Class A solid-state controller for induction motors rated in horsepower. Include electrical interlock and integral time delay transition between FORWARD and REVERSE rotation.
 - C. Control Voltage: 120 volts, 60 Hertz.
 - D. Overload Relay: NEMA ICS 2; melting alloy.

- E. Product Features:
 - 1. Auxiliary Contacts: NEMA ICS 2, 2 each field convertible contacts in addition to seal-in contact.
 - 2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oiltight type.
 - 3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
 - 4. Pushbuttons: Shrouded type.
 - 5. Indicating Lights: Transformer LED type.
 - 6. Selector Switches: Rotary type.
 - 7. Relays: NEMA ICS 2.
 - 8. Control Power Transformers: 120 volt secondary, 100 VA minimum, in each motor starter. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
- F. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole.

****** [OR] ******

G. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using motor circuit protector conforming to NEMA AB 1, with integral instantaneous magnetic trip in each pole. Obtain IEC Class 2 coordinated component protection.

****** [OR] ******

H. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using non-fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle.

****** [OR] *****

- I. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using fusible switch conforming to NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses. Obtain IEC Class 2 coordinated component protection.
- J. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type [3R] [4].
 - 3. [____] Locations: Type [____].

PART 3 - EXECUTION

- 3.1 EXISTING WORK
 - A. Disconnect and remove abandoned enclosed motor controllers.
 - B. Maintain access to existing enclosed motor controllers and other installations to remain active and to require access. Modify installation or provide access panel.
 - C. Clean and repair existing enclosed motor controllers to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install enclosed controllers plumb. Provide supports in accordance with Section 16070.
- B. Height:5 feet (1500 mm) to operating handle.
- C. Install fuses for fusible switches. Refer to Section 16491 for product requirements.
- D. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- E. Install engraved plastic nameplates. Refer to Section 16075 for product requirements and location.
- F. Neatly type label and place inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

3.3 FIELD QUALITY CONTROL

- A. See Division 1 Quality Requirements 01700 Execution Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION

SECTION 16441

SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes main and distribution switchboards.
- B. Related Sections:
 - 1. Section 16060 Grounding and Bonding for Electrical Systems.
 - 2. Section 16075 Identification for Electrical Systems.
 - 3. Section 16491 Fuses.
 - 4. Section 16210 Electrical Utility Services: Utility metering equipment.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C12.1 Code for Electricity Metering.
 - 2. ANSI C39.1 Requirements, Electrical Analog Indicating Instruments.
- B. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C57.13 Standard Requirements for Instrument Transformers.
 - 2. IEEE C62.41 Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- C. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA FU 1 Low Voltage Cartridge Fuses.
 - 3. NEMA KS 1 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 4. NEMA PB 2 Deadfront Distribution Switchboards.
 - 5. NEMA PB 2.1 General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less.
- D. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. See Division 1 for Submittal Procedures.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars for each phase, neutral, and ground; and switchboard instrument details.
- C. Product Data: Submit electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.
- D. Test Reports: Indicate results of factory production and field tests.

1.4 CLOSEOUT SUBMITTALS

- A. See Division 1 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations, configurations, and ratings of switchboards and their components on single line diagrams and plan layouts.
- C. Operation and Maintenance Data: Submit spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. See Division 1 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver in 48-inch maximum width shipping splits, individually wrapped for protection and mounted on shipping skids.
- C. Accept switchboards on site. Inspect for damage.
- D. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- E. Handle in accordance with NEMA PB 2.1. Lift only with lugs provided. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. See Division 1 Product Requirements.
- B. Conform to NEMA PB 2 service conditions during and after installation of switchboards.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 SEQUENCING

- A. See Division 1 Summary: Work sequence.
- B. Sequence Work to avoid interferences with building finishes and installation of other products.

1.10 MAINTENANCE MATERIALS

- A. See Division 1 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two of each key.
- C. Furnish two fuse pullers.

1.11 EXTRA MATERIALS

- A. See Division 1 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish three of each size and type of fuse installed.

PART 2 - PRODUCTS

2.1 DISTRIBUTION SWITCHBOARDS

- A. Manufacturers:
 - 1. General Electric.
 - 2. Siemens.
 - 3. Square D.
 - 4. Cutler Hammer.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA PB 2, dead front enclosed switchboard with electrical ratings and configurations as indicated on Drawings. Switchboard shall be equal to Square D Power-Style Multi-Section I-line switchboard.
- C. Service Conditions:
 - 1. Temperature: 120 degrees F.
 - 2. Altitude: 2500 feet.

D. Device Mounting:

- 1. Main Section: Panel mounted.
- 2. Distribution Section: Panel mounted.
- 3. Auxiliary Section: Individually mounted.
- E. Bus:
 - 1. Material: Copper with tin plating, standard size meeting UL 891 temperature rise requirements.
 - 2. Connections: Bolted accessible from front for maintenance with grade 5 carriage bolts and bellwire washers.
 - 3. Extend vertical and horizontal bus full length of switchboard.
 - 4. The bus bars shall be rigidly braced to comply with integrated rating of the switchboard.
- F. Ground Bus: Extend length of switchboard.
- G. Line and Load Terminations: Accessible from front only of switchboard, suitable for conductor materials and sizes as indicated on Drawings.
- H. Utility Metering Compartment: Furnish metering transformer compartment for Utility Company's use, in accordance with Utility Company requirements.
- I. Pull Section: Size as indicated on Drawings. width, depth and height to match switchboard. Arrange as indicated on Drawings.with pull section on Left or right side of switchboard as viewed from front.

- J. Future Provisions: Fully equip spaces for future devices with full-length bussing and bus connections, insulated and braced for short circuit currents. Furnish continuous current rating as indicated on Drawings.
- K. Enclosure: Type 1 General Purpose.][2 Raintight.
- L. Align sections at front and rear.
- M. The switchboard framework shall consist of steel channels welded or bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting. The framework is to be formed, code gauge steel, rigidly welded and bolted together to support all cover plates, busing and component devices during shipment and installation.
- N. Each switchboard section shall have an individual removable plate for installation and termination of conduit. The wireway front covers are to be hinged to permit access to the fusible switches or breaker load side terminals without removing the covers. All front plates used for mounting meter, selector switched or other front mounted devices shall be hinged with all wiring installed and laced with flexibility at the hinged side. All closure plates shall be screw removable.
- O. The main horizontal bus bars between sections shall be located at the back of the switchboard to permit a maximum of available conduit area.
- P. Each switchboard, as a complete unit, including service circuit breaker, shall be given a single withstand circuit rating by the manufacturer. The withstand short circuit current rating shall certify that all equipment is capable of withstanding the stress of a fault equal to the interrupting rating of the least overcurrent protective device contained herein. Such rating shall be established by actual tests by the manufacturer on the equipment constructed similarly to the subject switchboard. The test data shall be available and shall be furnished to the engineer, if requested, with or before the submittal of approval drawings.
- Q. Switchboard Height: 90 inches, excluding floor sills, lifting members and pull boxes.
- R. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.
- S. Mimic Bus: Show bussing, connections and devices in single line form on front panels of switchboard using blue color plastic strips, fastened flat against panel face with screws or rivets.

2.2 FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. General Electric.
 - 2. Siemens.
 - 3. Square D.
 - 4. Cutler Hammer.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA KS 1, Type HD, load interrupter knife switch. Handle lockable in OFF position.
- C. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.

2.3 FUSIBLE SWITCH ASSEMBLIES LARGER THAN 800 AMPERES

- A. Manufacturers:
 - 1. General Electric.
 - 2. Siemens.
 - 3. Square D.
 - 4. Cutler Hammer.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA KS 1, bolted pressure contact or high-pressure butt contact switch.
- C. Fuse Provisions: Designed to accommodate NEMA FU 1, Class L fuses.

2.4 MOLDED CASE CIRCUIT BREAKER

- A. Manufacturers:
 - 1. General Electric.
 - 2. Siemens.
 - 3. Square D.
 - 4. Cutler Hammer.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA AB 1, molded-case circuit breaker.
- C. Group mounted molded case circuit breakers are to be totally front accessible and front connective. The circuit breakers are to be mounted in the switchboard to permit installation, maintenance and testing without reaching over any line side bussing. The circuit breakers are to be removable by the disconnection of only the load side cable terminations and all line and load side connections are to be individual to each circuit breaker. No common mounting brackets or electrical bus connectors will be acceptable. Line side circuit breaker connections are to be jaw type plug-on.
- D. Circuit breakers shall be equipped with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Large permanent, individual circuit numbers shall be affixed to each breaker in a uniform position (or equip each breaker with a circuit card holder and neatly printed card identifying the circuit). Tripped indication shall be clearly shown by the breaker handle taking a position between ON and OFF. A trip button is to be provided for mechanically tripping the circuit breaker. This allows maintenance checks on the breaker, control circuits, alarm devices and other associated equipment. Provisions for additional breakers shall be such that no additional connectors will be required to add breakers. Provide phase loss and phase reversal sensing and tripping for circuit breakers indicated on the drawings. Indicator lights shall be provided adjacent to breaker to indicate phase loss or reversal tripping. Test button shall be provided.
- E. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have mechanism for adjusting short time continuous current, short time pickup current setting for automatic operation. Range of Adjustment: percent.
- F. Field-Changeable Ampere Rating Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have changeable trip units.
- G. Current Limiting Circuit Breaker: Circuit breaker indicated as current-limiting have automaticallyresetting current limiting elements in each pole. Let-through Current and Energy: Less than permitted for same size Class RK-5 fuse.

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- H. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing zero sequence type ground fault sensor; instantaneous trip; and adjustable short time trip.
- I. Current Limiter: Designed for application with molded case circuit breaker.
 - 1. Coordinate limiter size with trip rating of circuit breaker to prevent nuisance tripping and to achieve interrupting current rating specified for circuit breaker.
 - 2. Interlocks trip circuit breaker and prevent closing circuit breaker when limiter compartment cover is removed or when one or more limiter is not in place or has operated.
- J. Accessories: As indicated on Drawings. Conform to NEMA AB 1.
 - 1. Shunt Trip Device: [120] [_____] volts, [AC] [DC].
 - 2. Undervoltage Trip Device: [120] [____] volts, [AC] [DC].
 - 3. Handle Lock: Provisions for padlocking.

2.5 INSULATED CASE CIRCUIT BREAKER

- A. Manufacturers:
 - 1. General Electric.
 - 2. Siemens.
 - 3. Square D.
 - 4. Cutler Hammer.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA AB 1, enclosed, insulated-case circuit breaker.
- C. Trip Unit: Electronic sensing, timing, and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing zero sequence type ground fault sensor; instantaneous trip; and adjustable short time trip.
- D. Accessories: As indicated on Drawings. Conform to NEMA AB 1.
 - 1. Shunt Trip Device: [120] [_____] volts, [AC] [DC].
 - 2. Undervoltage Trip Device: [120] [_____] volts, [AC] [DC].
 - 3. Handle Lock: Provisions for padlocking.

2.6 GROUND FAULT DEVICES

- A. Manufacturers:
 - 1. General Electric.
 - 2. Siemens.
 - 3. Square D.
 - 4. Cutler Hammer.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Ground Fault Sensor: Zero sequence type.
- C. Ground Fault Relay: Adjustable ground fault sensitivity from 200 to 1200 amperes, time delay adjustable from 0 to 15 seconds. Furnish monitor panel with lamp to indicate relay operation, TEST and RESET control switches.

2.7 TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. Manufacturers:
 - 1. Surge Suppression Inc. Model L5EA3Y.
 - 2. Intermatic Model PG-4001.

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- 3. Liebent Corp. Model S1-025.
- 4. Control Concepts Inc. Model1H*200.
- 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- Β. Product Description: IEEE C62.41, factory-mounted transient voltage surge suppressor, selected to meet requirements for medium exposure and to coordinate with system circuit voltage.
- C. Integral Surge Suppressor:
 - Suppressors shall be component recognized in accordance with UL1449, Standard for 1. Safety, Transient Voltage Suppressors and UL 1283, Electromagnetic Interference Filters.
 - Suppressors shall be independently tested with the category C3 high exposure 2. waveform (20 kV-1.2/50us, 10kA-8/20 us) per IEEE C62.41-1991.
 - 3. Suppressors shall incorporate copper bus bars for the surge current path.
 - Suppressors shall be constructed using surge current modules (MOV based). Each 4. module shall be fused with user replaceable 200,000 AIR rated fuses. The status of each module shall be monitored on the front cover of the switchboard enclosure as well as on the module.
 - 5. Suppressors shall be equipped with an audible alarm which shall activate when any one of the surge current modules has failed. An alarm on/off switch shall be provided to silence the alarm and an alarm push-to-test switch shall be provided to test the alarm. The switches and alarm shall be located on the front cover of the switchboard enclosure.
 - 6. Suppressors shall meet or exceed the following criteria:

- Maximum single impulse current rating shall be no less than 120 kA per phase. a.
- Pulse Lift Test: Capable of protecting against and surviving 5000 IEEE C62.41 b. Category C transients without failure or degradation.

Voltage	L-N	N-G	L-Ğ
208Y/120	500V	500V	500V
480Y/277	1000V	1000V	1000V
	I		

The clamping voltage shall not exceed the following:

- 7. The suppressor shall have a response time no greater than five nanoseconds for any of the individual protection modes.
- 8. Suppressors shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.
- 9. Visible indication of proper suppressor connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable.
- Suppressors shall have a minimum EFI/RFI filtering of 34dB at 100Hz with an insertion 10. loss ratio of 50:1 using Mil Std. 220A methodology.

2.8 POWER METERS

- Manufacturers: Α.
 - Square D Model PM620. 1.
 - 2. General Electric.
 - 3. Siemens

C.

- Cutler Hammer. 4.
- 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- Β. Provide stand-alone, microprocessor based, three-phase power metering device, with six digit LED display and RS485 communications port. Shall provide 24-meter values including historical demand and consumption data. Shall be Square D Power Logic circuit monitor Model PM620 with digital display. Mount meter recessed in front of switchboard.

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16441 Page 7 C. Furnish meters with appropriate multiplier tags.

2.9 METERING TRANSFORMERS

- A. Manufacturers:
 - 1. General Electric.
 - 2. Square D.
 - 3. Siemens.
 - 4. Cutler Hammer.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Current Transformers: IEEE C57.13; 5 ampere secondary, bar or window type, with single secondary winding and secondary shorting device, primary/secondary ratio as indicated on Drawings, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.
- C. Potential Transformers: IEEE C57.13; 120 volt single secondary, disconnecting type with integral fuse mountings, primary/secondary ratio as indicated on Drawings, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

2.10 ACCESSORIES

- A. Circuit Breaker Lifting Device: Portable, floor supported, elevating carriage with roller base, for movement of circuit breakers in and out of switchboard structure.
- B. Furnish thermostatically controlled electric heaters in each section, sized to prevent condensation under expected weather conditions at Project site. Furnish terminals for separate connection of heater power circuit. Voltage Rating: 120 volts. Provide wire control transformer sized to match heaters.
- C. Furnish thermostatically controlled electric fans in each section, sized to prevent nuisance tripping based on the ambient operating temperatures expected at the project site. Furnish terminals for separate connections of fan power circuits voltage rating: 120 volts provide with control transformer sized to match fan motors.

2.11 SOURCE QUALITY CONTROL

- A. Furnish shop inspection and testing in accordance with NEMA PB 2.
- B. Make completed switchboard available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner and Engineer at least seven days before inspection is allowed.
- C. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify Owner and Engineer at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. See Division 1 Administrative Requirements: Coordination and project conditions.
 - B. Verify surface is suitable for switchboard installation.

SWITCHBOARDS

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3.2 EXISTING WORK

- A. Disconnect and remove abandoned switchboards.
- B. Maintain access to existing switchboards and other installations remaining active.
- C. Clean and repair existing switchboards to remain or to be reinstalled.

3.3 INSTALLATION

- A. Install in accordance with NEMA PB 2.1.
- B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.
- C. Install fuses in each switch and coordinate sizes with connected load.
- D. Install engraved plastic nameplates in accordance with Section 16075.
- E. Install typed breaker circuit directory.
- F. Ground and bond switchboards in accordance with Section 16060.

3.4 FIELD QUALITY CONTROL

- A. See Division 1 Quality Requirements and Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.1.

3.5 ADJUSTING

- A. See Division 1 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust operating mechanisms for free mechanical movement.
- C. Tighten bolted bus connections.
- D. Adjust circuit breaker trip and time delay settings to values as instructed by Architect/Engineer or per device coordination study.

3.6 CLEANING

- A. See Division 1 Execution and Closeout Requirements: Final cleaning.
- B. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

SWITCHBOARDS

SECTION 16442

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes distribution and branch circuit panelboards, electronic grade branch circuit panelboards.
- B. Related Sections:
 - 1. Section 16050 Basic Electrical Materials and Methods.

1.2 REFERENCES

- A. NECA (National Electrical Contractors Association) -Standard of Installation
- B. NEMA AB 1 (National Electrical Manufacturers Association) Molded Case Circuit Breakers.
- C. NEMA FU 1 (National Electrical Manufacturers Association) Fuses.
- D. NEMA ICS 2 (National Electrical Manufacturers Association) Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.
- E. NEMA ICS 5 (National Electrical Manufacturers Association) Industrial Control and Systems: Control Circuit and Pilot Devices.
- F. NEMA KS 1 (National Electrical Manufacturers Association) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- G. NEMA PB 1 (National Electrical Manufacturers Association) Panelboards.
- H. NEMA PB 1.1 (National Electrical Manufacturers Association) Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- I. NETA ATS (International Electrical Testing Association) Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems

1.3 SUBMITTALS

- A. Section 01300 Submittals.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- C. Product Data: Submit catalog data showing specified features of standard products.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01720 Project Record Documents.
- B. Section 01730 Operations and Maintenance Data.

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- C. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- D. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 MAINTENANCE MATERIALS

- A. Section 01750 Spare Parts and Maintenance Materials.
- B. Furnish two of each panelboard key. Panelboards keyed alike to Owner's current keying system.

PART 2 - PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

- A. Manufacturers:
 - 1. GE Electrical
 - 2. Siemens.
 - 3. Square D.
 - 4. Cutler-Hammer.
 - 5. Substitutions: Section 01600 Product Requirements.
- B. Product Description: NEMA PB 1, circuit breaker type.
- C. Panelboard Bus: Copper, current carrying components, ratings as indicated. Provide copper ground bus in each panelboard.
- D. Minimum integrated short circuit rating: as indicated on schedules.
- E. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- F. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
- G. Enclosure: NEMA PB 1, Type 1, cabinet box.
- H. Cabinet Front: Surface type, fastened with [crews, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

2.2 BRANCH CIRCUIT PANELBOARDS

- A. Manufacturers:
 - 1. GE Electrical.
 - 2. Siemens.
 - 3. Square D.
 - 4. Cutler-Hammer.

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- 5. Substitutions: Section 01600 Product Requirements.
- B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- C. Panelboard Bus: Copper, current carrying components, ratings as indicated. Provide copper ground bus in each panelboard.
- D. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.
 - 1. Series rating is allowed for branch circuit breakers only.
- E. Enclosure: NEMA PB 1, Type 12. 1. Type 12.
- F. Cabinet Box: 6 inches deep, 20 inches wide 240 volt and 480 volt panelboards.
- G. Cabinet Front: Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike to match current keying system used at the site. Finish in manufacturer's standard gray enamel.

2.3 ELECTRONIC CIRCUIT PANELBOARDS

- A. Integral Surge Suppressor:
 - 1. Suppressors shall be component recognized in accordance with UL1449, Standard for Safety, Transient Voltage Surge Suppressors and UL 1283, Electromagnetic Interference Filters.
 - 2. Suppressors shall be independently tested with the category C3 high exposure waveform (20 kV-1.2/50us, 10kA-8/20 us) per IEEE C62.41-1991.
 - 3. Suppressors shall incorporate copper bus bars for the surge current path.
 - 4. Suppressors shall be constructed using surge current modules (MOV based). Each module shall be fused with user replaceable 200,000 AIR rated fuses. The status of each module shall be monitored on the front cover of the panelboard enclosure as well as on the module.
 - 5. Suppressors shall be equipped with an audible alarm which shall activate when any one of the surge current modules has failed. An alarm on/off switch shall be provided to silence the alarm and an alarm pus-to-test switch shall be provided to test the alarm. The switches and alarm shall be located on the front cover of the panelboard enclosure.
 - 6. Suppressors shall meet or exceed the following criteria:
 - a. Maximum single impulse current rating shall be no less than 120 kA per phase.
 - b. Pulse Lift Test: Capable of protecting against and surviving 5000 IEEE C62.41 Category C transients without failure or degradation.
 - c. The clamping voltage shall not exceed the following:

Voltage	L-N	N-G	L-G
208Y/120	500V	500V	500V
480Y/277	1000V	1000V	1000V

- 7. The suppressor shall have a response time no greater than five nanoseconds for any of the individual protection modes.
- 8. Suppressors shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.
- 9. Visible indication of proper suppressor connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable.

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PANELBOARDS

- 10. Suppressors shall have a minimum EFI/RFI filtering of 34dB at 100Hz with an insertion loss ratio of 50:1 using Mil Std. 220A methodology.
- B. Panelboard:
 - 1. The panelboard shall be UL 67 Listed and the TVSS device shall be UL 1449 Component Recognized. The TVSS shall have passed all UL testing required by the UL 1449 standard. Panelboard markings shall include clamp voltage at the TVSS terminals as well as clamp voltage at the panelboard line terminals.
 - 2. The unit shall top or bottom feed according to requirements. A circuit directory shall be located inside the door.
 - 3. The box shall be galvanized steel. The box size shall be as indicated on the associated schedules.
 - 4. The main bus shall be aluminum and rated for the load current required.
 - 5. The interior shall be provided with branch circuit breakers as required. One 60A circuit breaker, with the appropriate number of poles, shall be provided as a dedicated disconnect for the TVSS.
 - 6. The unit shall include a 200% rated neutral assembly with aluminum neutral bus.
 - 7. The unit shall have wiring gutters conforming to the requirements of the NEC.
 - 8. The field connections to the panelboard shall be main lug or main breaker.
 - 9. The unit shall be constructed with flush or surface mounted trim and shall be in a NEMA Type 1 enclosure.
 - 10. The panelboard shall be supplied with the appropriate branch breaker positions and nominal current rating as indicated on the associated schedules.
 - 11. Type HACR circuit breakers shall be provided for air conditioning equipment circuits.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1 and NECA "Standard of Installation."
- B. Install panelboards plumb.
- C. Install recessed panelboards flush with wall finishes.
- D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- E. Install filler plates for unused spaces in panelboards.
- F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.
- G. Install engraved plastic nameplates in accordance with Section 16075.
- H. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: 5 empty 1 inch. Identify each as SPARE.
- I. Ground and bond panelboard enclosure according to Section 16060.
- 3.2 FIELD QUALITY CONTROL
 - A. Section 01400 Quality Control.
 - B. Inspect and test in accordance with NETA ATS, except Section 4.

- C. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.
- D. Perform switch inspections and tests listed in NETA ATS, Section 7.5.
- E. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.3 ADJUSTING

- A. Section 01650 Starting of Systems.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

PANELBOARDS

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SECTION 16461

DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes two-winding transformers.

1.2 REFERENCES

- A. NEMA ST 1 (National Electrical Manufacturers Association) Specialty Transformers (Except General-Purpose Type).
- B. NEMA ST 20 (National Electrical Manufacturers Association) Dry-Type Transformers for General Applications.
- C. NETA ATS (International Electrical Testing Association) Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Section 01300 Submittals.
- B. Product Data: Submit outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.
- C. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01720 Project Record Documents.
- B. Project Record Documents: Record actual locations of transformers.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01600 Material and Equipment.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

- A. Manufacturers:
 - 1. Square D.
 - 2. General Electric.
 - 3. Siemens.
 - 4. Cutler-Hammer
 - 5. Substitutions: Section 01630 Substitutions.
- B. Product Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers, ratings as indicated.
- C. Primary Voltage: 480 volts, 3 phase.
- D. Secondary Voltage: 208Y/120 volts, 3 phase.
- E. Insulation system and average winding temperature rise for rated kVA as follows:
 - 1. 1-15 kVA: Class 185 with 115 degrees C rise.
 - 2. 16-500 kVA: Class 220 with 80 degrees C rise.
- F. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.
- G. Winding Taps:
 - 1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 - 2. Transformers 15 kVA and Larger: NEMA ST 20.
- H. Sound Levels: NEMA ST 20.
- I. Basic Impulse Level: 10 kV.
- J. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- K. Mounting:
 - 1. 1-15 kVA: Suitable for wall mounting.
 - 2. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
 - 3. Larger than 75kVA: Suitable for floor or trapeze mounting.
- L. Coil Conductors: Continuous copper windings with terminations brazed or welded.
- M. Enclosure: NEMA ST 20, Type 1. Provide lifting eyes or brackets.1. Type 1 ventilated.
- N. Isolate core and coil from enclosure using vibration-absorbing mounts.
- O. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.
- P. Impedance for units rated 15kVA and above shall be minimum 5%. Below 15kVA, impedance shall be minimum 3%.

2.2 SOURCE QUALITY CONTROL

A. Production test each unit according to NEMA ST20.

PART 3 - EXECUTION

- 3.1 EXAMINATION
 - A. Section 01040 Coordination.
 - B. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.2 EXISTING WORK

A. Disconnect and remove abandoned transformers.

3.3 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, under the provisions of Section 16130, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Support transformers according to Section 16070.
 - 1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.
 - 2. Mount floor-mounted transformers on double deflection neoprene mounts with minimum static deflection of .3 inches.
- D. Provide seismic restraints.
- E. Provide grounding and bonding in accordance with Section 16060.
- F. Transformers exposed to weather or located in areas other than dedicated electrical rooms shall have NEMA 3R housings and supplemental internal rodent/tamper screens to preclude the entry of foreign materials.

3.4 FIELD QUALITY CONTROL

- A. Section 01400 Quality Control.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.5 ADJUSTING

- A. Section 01650 Starting of Systems.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

DRY TYPE TRANSFORMERS

SECTION 16491

FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fuses and spare fuse cabinet.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
1. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.3 DESIGN REQUIREMENTS

- A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for the following components: wire, cable, bus structures, and other equipment. Design system to maintain component damage within acceptable levels during faults.
- B. Select fuses to coordinate with time current characteristics of other overcurrent protective elements, including other fuses, circuit breakers, and protective relays. Design system to maintain operation of device closest to fault operates.

1.4 FUSE PERFORMANCE REQUIREMENTS

- A. Main Service Switches Larger than 600 amperes: Class L (time delay), Class T.
- B. Main Service Switches: Class RK1 (time delay), RK5 (time delay).
- C. Power Load Feeder Switches Larger than 600 amperes: Class L (time delay).
- D. Power Load Feeder Switches: Class RK1 (time delay), RK5.
- E. Motor Load Feeder Switches: Class RK1 (time delay), RK5, J (time delay).
- F. Lighting Load Feeder Switches Larger than 600 amperes: Class L (time delay).
- G. Lighting Load Feeder Switches: Class RK1 (time delay), RK5, J (time delay).
- H. Other Feeder Switches Larger than 600 amperes: Class L (time delay).
- I. Other Feeder Switches: Class RK1 (time delay), RK5, J (time delay).
- J. General Purpose Branch Circuits: Class RK1 (time delay), RK5, J (time delay).
- K. Motor Branch Circuits: Class RK1 (time delay), RK5.
- L. Lighting Branch Circuits: Class G.

1.5 SUBMITTALS

- A. See Division 1 for Submittal Procedures.
- B. Product Data: Submit data sheets showing electrical characteristics, including time-current curves.

1.6 CLOSEOUT SUBMITTALS

- A. See Division 1 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual sizes, ratings, and locations of fuses.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.8 MAINTENANCE MATERIALS

- A. See Division 1 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two fuse pullers.

1.9 EXTRA MATERIALS

- A. See Division 1 Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish three spare fuses of each Class, size, and rating installed.

PART 2 - PRODUCTS

2.1 FUSES

- A. Manufacturers:
 - 1. Buss Mann Division; McGraw Edison Company.
 - 2. General Electric Company.
 - 3. Gould, Inc.
 - 4. Chase Showmat.
 - 5. Littlefuse, Inc.
 - 6. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
- C. Voltage: Rating suitable for circuit phase-to-phase voltage.
- D. Provide fuses of types, sizes, ratings, and average time / current and peak let-through current characteristics, indicated, which comply with manufacturer's standard design, materials, and construction in accordance with published product information, and with industry standards and configurations.

- E. Class CC Fast Acting Fuses:
 - 1. Provide UL Class CC fast acting fuses rated 600 V, 60 Hz, 1/10 to 30 amperes with 200,000 RMS symmetrical interrupting current rating for protecting motor control circuits, lighting ballasts, and control transformers.
- F. Class RK1 Time Delay Fuses:
 - 1. Provide UL Class RK1 time delay fuses rated 250 or 600 V, 60 Hz, up to 600 amperes, with 200,000 RMS symmetrical interrupting current rating for protecting circuit breakers.
- G. Class RK5 Time Delay Fuses:
 - 1. Provide UL Class RK5 time delay fuses rated 250 or 600 V, 60 Hz, up to 600 amperes, with 200,000 RMS symmetrical interrupting current rating for protecting motors.

2.2 SPARE FUSE CABINET

- A. Product Description: Wall-mounted sheet metal cabinet with shelves, suitably sized to store spare fuses and fuse pullers specified.
- B. Doors: Hinged, with hasp for Owner's padlock.
- C. Finish: Gray enamel.

PART 3 - EXECUTION

- 3.1 EXISTING WORK
 - A. Remove fuses from abandoned circuits.
 - B. Maintain access to existing fuses and other installations remaining active and requiring access. Modify installation or provide access panel.
- 3.2 INSTALLATION
 - A. Install fuse with label oriented so manufacturer, type, and size are easily read.
 - B. Install spare fuse cabinet as indicated on Drawings.

END OF SECTION

SECTION 16500

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Remote control lighting relays.
 - 2. Lighting contactors.
 - 3. Switches.
 - 4. Switch plates.
 - 5. Occupancy sensors.
 - 6. Photocells.
 - 7. Photocell control unit.
- B. Related Sections:
 - 1. Section 16150 Equipment Wiring Connections: Execution requirements for electric connections specified by this section.
 - 2. Section Low-Voltage Electrical Power Conductors and Cables.
 - 3. Section 16128 Raceway and Boxes for Electrical Systems: Product requirements for raceway and boxes for placement by this section.
 - 4. Section 16075 Identification for Electrical Systems: Product requirements for electrical identification items for placement by this section.
 - 5. Section 16442 Panelboards.
 - 6. Section 16140 Wiring Devices: Product requirements for wiring devices for placement by this section.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA FU 1 Low Voltage Cartridge Fuses.
 - 3. NEMA ICS 2 Industrial Control and Systems: Controllers, Contractors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 4. NEMA ICS 4 Industrial Control and Systems: Terminal Blocks.
 - 5. NEMA ICS 5 Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 6. NEMA ICS 6 Industrial Control and Systems: Enclosures.
 - 7. NEMA KS 1 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

1.3 SYSTEM DESCRIPTION

- A. Distributed switching control using self contained individually mounted lighting relays.
- B. Where indicated on drawings or required by applicable code, provide automatic shutoff for lighting inside building larger than 5000 square feet (465 square meters). Control shutoff by method conforming to ICC IECC.
- C. Where indicated on drawings or required by applicable code, provide automatic shutoff for lighting outside building. Control shutoff by method conforming to ICC IECC.

1.4 SUBMITTALS

- A. See Division 1 for Submittal Procedures.
- B. Shop Drawings: Indicate dimensioned drawings of lighting control system components and accessories.
 - 1. One Line Diagram: Indicating system configuration indicating panels, number and type of switches or devices.
 - 2. Include typical wiring diagrams for each component.
- C. Product Data: Submit manufacturer's standard product data for each system component.
- D. Manufacturer's Installation Instructions: Submit for each system component.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. See Division 1 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record the following information:
 - 1. Actual locations of components and record circuiting and switching arrangements.
 - 2. Wiring diagrams reflecting field installed conditions with identified and numbered, system components and devices.
- C. Operation and Maintenance Data:
 - 1. Submit replacement parts numbers.
 - 2. Submit manufacturer's published installation instructions and operating instructions.
 - 3. Recommended renewal parts list.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. See Division 1 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept components on site in manufacturer's packaging. Inspect for damage.
- C. Protect components by storing in manufacturer's containers indoor protected from weather.

1.8 WARRANTY

- A. See Division 1 Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five year manufacturer warranty for components.

1.9 EXTRA MATERIALS

- A. See Division 1 Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish two of each switch type.

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- C. Furnish two of each occupancy sensor type.
- D. Furnish two of each photocell type.

PART 2 - PRODUCTS

2.1 REMOTE CONTROL LIGHTING RELAYS

- A. Manufacturers:
 - 1. Automatic Switch Co.
 - 2. Cutler-Hammer.
 - 3. Square D.
 - 4. General Electric.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: Heavy duty, single-coil momentary contact mechanically held remote control relays.
- C. Contacts: Rated 20 amperes at 277 volts. Rated for lighting applications with high intensity discharge (HID), quartz halogen, tungsten, and fluorescent lamps.
- D. Line Voltage Connections: Clamp type screw terminals.
- E. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 4.

2.2 LIGHTING CONTACTORS

- A. Manufacturers:
 - 1. Automatic Switch Co.
 - 2. Cutler-Hammer.
 - 3. Square D.
 - 4. General Electric.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: NEMA ICS 2, magnetic lighting contactor.
- C. Configuration: Electrically held 2 wire control.
- D. Coil Operating Voltage: 120 volts, 60 Hertz.
- E. Poles: To match circuit configuration and control function.
- F. Contact Rating: Conductor overcurrent protection, considering derating for continuous loads.
- G. Accessories:
 - 1. Cover Mounted Pilot Devices: NEMA ICS 5, heavy-duty oiltight type with Form Z contacts, rated A150.
 - 2. Pushbutton: ON/OFF function, with shrouded configuration.
 - 3. Selector Switch: ON/OFF/AUTOMATIC function, with rotary action.
 - 4. Indicating Light: Red lens, transformer type, with led lamp.
 - 5. Auxiliary Contacts: One field convertible in addition to seal-in contact.

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- 6. Relays: NEMA ICS 2.
- 7. Control Power Transformers: 120 volt secondary, 120 VA minimum, in each enclosed contactor. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
- H. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 4.

2.3 SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated.
 - 2. Leviton Manufacturing Co., Inc.
 - 3. Pass and Seymour/Legrand.
 - 4. Substitutions: See Division for Product Requirements and Substitution Procedures.
- B. Wall Switch: Specification Grade, momentary pushbutton type for overriding relays.
 - 1. Material: Plastic.
 - 2. Color: White.
- C. Key Switch: Spade key type. Match non-key switch ratings.
- D. Switches with Pilot Lamp: Momentary contact, three position rocker type, white color, rated 3 amperes at 25 VAC, with integral red pilot light.

2.4 SWITCH PLATES

- A. Manufacturers:
 - 1. Hubbell Incorporated.
 - 2. Leviton Manufacturing Co., Inc.
 - 3. Pass and Seymour/Legrand.
 - 4. Substitutions: See Division for Product Requirements and Substitution Procedures.
- B. Product Description: Specification Grade.
 - 1. Material: Plastic.
 - 2. Color: White.

2.5 OCCUPANCY SENSOR

- A. Manufacturers:
 - 1. Hubbell Incorporated Model Omni-DT-2000.
 - 2. Sensor Switch Model CM-PDT-10.
 - 3. Watt Stopper Model DT-300.
 - 4. Substitutions: See Division for Product Requirements and Substitution Procedures.
- B. Compatible with modular relay panels. Capable of being wired directly to Class 2 wiring without auxiliary components or devices.
- C. Separate sensitivity and time delay adjustments with LED indication of sensed movement. User adjustable time-delay: 30 seconds to 12 minutes.
- D. Furnish with manual override.

- E. Operation: Silent.
- F. Room Sensors: As indicated on Drawings.
- G. Corridor and Hallway Sensors:
 - 1. Capable of detecting motion 14 feet (4 m) wide and 80 feet (24 m) long with one sensor mounted 10 feet (3 m) above floor.
 - 2. Capable of detecting motion in warehouse aisle 10 feet (3 m) wide and 60 feet (18 m) long or 100 feet (30 m) long when mounted 22 feet (7 m) above floor.
 - 3. Capable of being wired in master-slave configuration to extend area of coverage.
- H. Description: Dual technology sensor, using passive infrared and ultrasonic or microphonic technology, ceiling mount occupancy sensor.
- I. Sensor shall have up to 2000 square feet coverage.
- J. The ultrasonic frequency shall be minimum of 32 kHZ.
- K. Provide with temperature and humidity resistant receivers and a LED indicator.
- L. Provide with power pack and/or slave pack as required.
- M. Adjusting: Contractor to adjust all sensors as follows:
 - 1. PIR and Ultrasonic detection required to turn "on" lights.
 - 2. No occupancy time delay at 10 minutes.
 - 3. PIR and Ultrasonic sensitivity to be set so that lights turn-on before occupant proceeds more than 5 feet into room.
 - 4. Contractor to set and test all motion sensors 30 days prior to substantial completion.
 - 5. Contractor to cooperate with commissioning agent to test and verify sensor settings are as specified.

2.6 PHOTOCELLS

- A. Manufacturers:
 - 1. Douglas Lighting Controls.
 - 2. MYTECH Corporation.
 - 3. Novita.
 - 4. Watt Stopper.
 - 5. Substitutions: See Division for Product Requirements and Substitution Procedures.
- B. General: Consist of sensor mounted with separate control-calibration module. Sensor connected to control-calibration module via single shielded conductor with maximum distance of 500 feet. Control unit powered by 24 VAC.
- C. Control-Calibration Module: Furnish with the following:
 - 1. Capable of being switched between 4 measurement ranges.
 - 2. Separate trip points for high and low response settings.
 - 3. Momentary contact device to override photocell relays.
 - 4. Three minute time delay between switching outputs to avoid nuisance tripping.
- D. Sensor Devices: Each sensor employs photo diode technology to allow linear response to daylight within illuminance range.
 - 1. Exterior Lighting: Hooded sensor, horizontally mounted, employing flat lens, and working range 1-10 footcandles in 10 percent increments. Entire sensor encased in optically clear epoxy resin.

- 2. Indoor Lighting: Sensor with Fresnel lens providing for 60 degree cone shaped response area to monitor indoor office lighting levels.
- 3. Atriums: Sensor with translucent dome with 180 degree field of view and respond in range of 100-1,000 footcandles.
- 4. Skylights: Sensor with translucent dome with 180 degree field of view and respond in range of 1,000-10,000 footcandles.

2.7 PHOTOCELL CONTROL UNIT

- A. Manufacturers:
 - 1. Douglas Lighting Controls.
 - 2. MYTECH Corporation Model.
 - 3. Novitas.
 - 4. Watt Stopper.
 - 5. Substitutions: See Division 1 for Product Requirements and Substitution Procedures.
- B. Product Description: Photodiode control unit with PHOTOCELL ENABLE and MASTER OVERRIDE inputs for remote control, 3 minute time delay, and with selectable ranges for 1-10 footcandle, 10-100 footcandle, 100-1000 footcandle and 1000-10,000 footcandle.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount switches, occupancy sensors, and photocells as indicated on Drawings.
- B. Install wiring in accordance with Section 26 05 19.
- C. Use only properly color coded, stranded wire. Install wire sizes as indicated on Drawings. Install wire in conduit in accordance with Section 26 05 33.
- D. Label each low voltage wire clearly indicating connecting relay panel. Refer to Section 26 05 53.
- E. Mount relay as indicated on Drawings. Wire numbered relays in panel to control power to each load. Install relays to be accessible. Allow space around relays for ventilation and circulation of air.
- F. Identify power wiring with circuit breaker number controlling load. When multiple circuit breaker panels are feeding into relay panel, label wires to indicate originating panel designation.
- G. Label each low voltage wire with relay number at each switch or sensor.

3.2 MANUFACTURER'S FIELD SERVICES

- A. See Division 1 Quality Requirements: Requirements for manufacturer's field services.
- B. Furnish services for minimum of one day for check, test, and start-up. Perform the following services:
 - 1. Check installation of panelboards.
 - 2. Test operation of remote controlled devices.
 - 3. Repair or replace defective components.

3.3 ADJUSTING

- A. See Division 1 Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Test each system component after installation to verify proper operation.
- C. Test relays, contactors, and switches after installation to confirm proper operation.
- D. Confirm correct loads are recorded on directory card in each panel.

3.4 DEMONSTRATION

- A. See Division 1 Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate operation of the following system components:
 - 1. Operation of switches. Demonstrate for all zones.
 - 2. Operation of each type of occupancy sensors. Demonstrate for all zones.
 - 3. Operation of each type of photocell. Demonstrate for all zones.
- C. Furnish 4 hours to instruct Owner's personnel in operation and maintenance of system. Schedule training with Owner, provide at least 7 days notice to Owner and Engineer of training date.

END OF SECTION

SECTION 16510

INTERIOR LUMINAIRES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes interior luminaires, lamps, ballasts, and accessories.

1.2 REFERENCES

- A. ANSI C82.1 Ballasts for Fluorescent Lamps Specifications.
- B. ANSI C82.4 Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).

1.3 SUBMITTALS

- A. Submit under provisions of General Conditions.
- B. Shop Drawings: Indicate dimensions and components for each luminaire not standard product of manufacturer.
- C. Product Data: Submit dimensions, ratings, and performance data.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.5 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.6 MAINTENANCE MATERIALS

- A. Section 01750 Spare Parts and Maintenance Materials.
- B. Furnish four of each plastic lens type.
- C. Furnish ten replacement lamps for every 100 of each type of lamp installed, but not less than 10.
- D. Furnish two of each ballast for every 100 of each type of ballast installed, but not less than 2.
- E. Furnish three wireless infrared transmitters.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES

- A. Section 01600 Material and Equipment.
- B. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.

2.2 FLUORESCENT BALLASTS

A. Product Description: Electronic ballast, rapid start less than 10 percent THD, suitable for lamps specified, with voltage to match luminaire voltage.

2.3 DIMMABLE FLUORESCENT BALLASTS

- A. The ballast shall be physically interchangeable with a standard electromagnetic or standard electronic ballast.
- B. The electronic ballast shall be provided with integral leads or color-coded connectors that comply with ANSI standard C82.11 (latest revision).
- C. Ballast shall operate from a nominal line voltage of 120 or 277 volts, +/- 10%, 60Hz.
- D. For T8 and CFL, ballast shall control lamp light output from a ballast factor of 1.0 to .05 (100% -5% relative light output). For T5/HO, ballast shall control lamp light output from a ballast factor of 1.0 to 0.03 (100% - 1% relative light output).
- E. Ballast ANSI input wattage must be listed clearly in the catalog, and be 35, 70, and 104 watts or less for 1, 2, and 3 F32T8 applications, respectively.
- F. Ballast shall maintain constant light output for a line voltage variation of +/-10%.
- G. The electronic ballast's input current shall have a total Harmonic Distortion (THD) of less than 10% at maximum light-output.
- H. The electronic ballast shall have a Power Factor greater than 98% when used with primary lamp.
- I. The electronic ball shall have Lamp Current Crest Factor of less than 1.7 throughout the dimming range.
- J. The electronic ballast shall withstand a sustained short to ground or open circuit of any output leads.
- K. The electronic ballast shall be sound rated A.
- L. Dimmable fluorescent ballast for operation with dimmer system shall be electronic, line voltage suitable for use with the supplied dimmer system.
- M. Manufacturer:
 - 1. Advance Mark X.
 - 2. Substitutions: Under provisions of General Requirements.

2.4 HIGH INTENSITY DISCHARGE (HID) BALLASTS

A. Product Description: ANSI C82.4, metal halide high pressure sodium lamp ballast, suitable for lamp specified, with voltage to match luminaire voltage.

2.5 FLUORESCENT LAMPS

- A. Manufacturers:
 - 1. Philips Electronics: Alto with reduced mercury.
 - 2. General Electric reduced mercury.
 - 3. Sylvania / Osram reduced mercury.
 - 4. Substitutions: Under provisions of General Requirements.

2.6 HID LAMPS

- A. Manufacturers:
 - 1. Philips Electronic North America.
 - 2. General Electric.
 - 3. Sylvania / Osram.
 - 4. Substitutions: Under provisions of General Requirements.

2.7 GENERATOR TRANSFER DEVICE

- A. Manufacturer:
 - 1. Bodine.
 - 2. Substitutions: Under provisions of General Requirements.
- B. Product Description: The device shall be capable of bypassing the wall switch when the auxiliary generator power lighting. The device shall consist of relay switching circuitry and fusing contained in one 8.00" x 1.18" x 1.18" galvanized steel case; shall operate at 120 or 277 VAC, 60 Hz; shall have all inputs fused to 3 A maximum; shall draw 280 mA and 1.6 Watts during normal operation; and shall comply with current NEC. The device shall be UL Listed for installation inside, on top of, or remote from the fixture, warranted for a full five years from date of purchase, and made in the U.S.A.

2.8 DIMMER SYSTEM

- A. Manufacturer:
 - 1. Leviton.
 - 2. Lithonia.
 - 3. Lutron.
 - 4. Substitutions
- B. The entire control system shall be U.L., SCA or CE marked as appropriate. Dimmers shall be U.L. listed and CSA Approved specifically for the required loads (i.e., incandescent, fluorescent, magnetic low voltage transformer). Manufacturer shall provide file card upon request.
- C. All lighting control equipment dimming ballasts, control panel, and controls shall be manufacturered by a single manufacturer.
- D. Manufacturer shall maintain ISO 9001 certification.

- E. Dimmers shall operate the following sources / load types with a smooth dimming curve. Dimmers shall also be capable of operating these sources on a non-dim basis. Dimmers shall be electronically assigned to the appropriate load type / dimming curve and can be reassigned at any time. Universal-type dimmers that do not adjust the dimming curve shall not be acceptable.
 - 1. Incandescent, Tungsten and Magnetic Low Voltage Transformer.
 - a. Dimmer shall contain circuitry specifically designed to control and provide a symmetrical AC waveform to the input of magnetic low voltage transformers.
 - b. Dimmer shall not cause a magnetic low voltage transformer to operate above the transformer's rated operating current and temperature.
 - Dimmer shall contain circuitry to control dioded lamps.
 - 2. Electronic Low Voltage Transformer.

C.

- a. Flicker or interaction shall occur at any point in the dimming range.
- b. Fir integral dimming, an interface shall be required.
- 3. Fluorescent Electronic Dimming Ballasts.
 - a. Dimmer shall be rated to control T-12, T-12 high output, T-8, T-5 and T-4 lamps. All lamps on the same circuit must have the same current rating (i.e., T-8), but may be different lengths (i.e., 3'4'). Ballasts for fluorescent fixtures must be Lutron H0-lume "FDB" or Eco-10 series. Dimmer shall be rated to control T-8 and compact fluorescent lamps with line voltage dimming ballasts similar to the Advance Mark X.
 - b. Ballasts shall be inaudible in a 27dB ambient throughout the dimming range.
 - c. Ballasts shall be capable of striking lamps at any light level. This shall be accomplished without first flashing to full light.
 - d. Ballasts must comply with FCC part 18 regulations for non-commercial RF lighting devices.
 - e. Dimming range of ballasts shall be from 100% to 10% light level.
 - f. Ballasts shall have: a power factor greater than .95; a ballast factor equal to .85 throughout the entire dimming range; magnitude of harmonic distortion shall not exceed 10%THD of current at full light output; lamp current crest factor less than or equal to 1.6.
- F. Control
 - 1. Preset dimming control shall provide power failure memory. Should power be interrupted and subsequently returned, the lights will come back on the same levels set prior to the power interruption. Restoration to some other default level is not acceptable, unless specifically noted elsewhere.
 - 2. Wiring form dimming panel to preset dimming control and accessory control shall be low voltage type Class 2 wiring (SELV).
 - 3. Where indicated on the drawings, control shall provide preset lighting scenes for up to 512 zones in any combination of groups or area. System set up shall provide capability to: Assign dimmers to specific zones, define the number of areas, define the number of zones per area, define wallstation functionality, set the astronomic timeclock based on longitude, latitude, and daylight savings schedule, label all area, zones, scenes, and wallstation, plan exception schedules up to one year in advance.
 - 4. An integral timeclock shall execute any of the following events: select present scenes, enable disable control stations, start/stop sequences, select OMX-DACPI scene banks. Commands can be in either real or astronomic (relating to sunrise / sunset) time. Timeclock shall automatically correct for daylight savings time and leap year when appropriate. There shall be a total of 10 timeclock schedules available per area (one per day per week, plus three special schedules). Schedules shall be capable of being stored in a "calendar" up o 60 events. The timeclock can be enabled or disabled for any area via the computer of local accessory controls.

- 5. In the event that any of the communication lines to any of the dimmer and/or relay panels is interrupted for any reason, the lights controlled by those panels shall remain at their current levels until the interruption is cleared. In the event of a control station failure or interruption of a communication line to any of the controls, the lights controlled by those stations shall remain at their current levels. The control system shall have non-volatile memory backup that can store all system data for one year minimum. It shall not be necessary to re-boot the system manually nor use any tape of floppy disk/hard drive to restore the system once power has been restored system shall automatically return to its previous state. The main processor shall be protected by an integral isolation transformer and shall meet the ANSI/IEEE specification for transient protection (Ref, 2.02).
- 6. Accessory Control Options Provide the following controls shown on the drawings:
 - a. Two Scene Entrance Control(s) shall be capable of recalling Scene One plus Off.
 - b. Four Scene Control(s) shall be capable of recalling any one of four scenes, master raise / lower and Off. Control shall provide access to up to 16 scenes.
 - c. Wireless Infrared Transmitter(s) shall be capable of recalling any one of four present scenes and Off. In addition, a master raise/lower shall be provided. The transmitter shall be manufactured by the dimming system manufacturer. The range shall be a least 50 feet.
 - 1) Wall receiver shall incorporate four scene select, master raise/lower, and off buttons.
 - d. Equipment Interface(s) shall allow access to preset dimming control(s) via one of the following methods:

PART 3 - EXECUTION

- 3.1 EXISTING WORK
 - A. Disconnect and remove abandoned luminaires, lamps, and accessories.
 - B. Extend existing interior luminaire installations using materials and methods compatible with existing installations, or as specified.
 - C. Clean and repair existing interior luminaires to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.
- B. Support luminaires independent of ceiling framing.
- C. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- D. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- E. Exposed Grid Ceilings: Support surface-mounted luminaires on grid ceiling directly from building structure. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.
- F. Install recessed luminaires to permit removal from below.

- G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- H. Install clips to secure recessed grid-supported luminaires in place.
- I. All fluorescent luminaries shall be provided with earthquake straps.
- J. Install wall-mounted luminaires at height as indicated on Drawings.
- K. Install accessories furnished with each luminaire.
- L. Connect luminaires to branch circuit outlets provided under Section 16130 using flexible conduit, maximum length of 6'.
- M. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- N. Install specified lamps in each luminaire.
- O. Ground and bond interior luminaires in accordance with Section 16060.
- P. Meet with owner to develop and program 4 presets each for Lecture hall 144 and Lecture Hall 148.
- Q. Provide typed dimmer panel schedule indicating at a minimum dimmer circuit, zone, dimmer function, type of light, room area controlled and present information including zone status at each present selection.
- 3.3 FIELD QUALITY CONTROL
 - A. Section 01650 Starting of Systems.
 - B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- 3.4 ADJUSTING
 - A. Section 01650 Starting of Systems.
 - B. Aim and adjust luminaires as indicated on Drawings.

3.5 DEMONSTRATION AND TRAINING

- A. Section 01670 system Demonstration.
- B. Furnish 2 hours of instruction each for two persons, of dimmer system, to be conducted at project site with manufacturer's representative.

3.6 CLEANING

- A. Section 01710 Final Cleaning.
- B. Remove dirt and debris from enclosures.
- C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

3.7 PROTECTION OF FINISHED WORK

- A. Section 01500 Controls.
- B. Relamp luminaires having failed lamps at Substantial Completion.

END OF SECTION

SECTION 16520

INTERIOR LIGHTING - SOLID STATE LIGHTING (SSL)

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. LED lamps
- B. LED Dimming Drivers
- C. Integral lighting controls

1.2 RELATED DOCUMENTS

- A. Section 16140 Wiring Devices
- B. Section 16500 Lighting Control Devices

1.3 REFERENCE STANDARDS

- A. National Energy Policy Act of 2005, Public Law No. 109-58.
- B. IESNA LM-63 ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002.
- C. NFPA 70 National Electrical Code; National Fire Protection Association; 2008.
- D. IESNA LM-79-08 IESNA Approved Method for Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.
- E. IESNA LM-80-08 IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- F. IESNA TM-21-2011 Projecting Long Term Lumen Maintenance of LED Light Sources.
- G. UL 1310 and 8750 Light Emitting Diode (LED) Equipment for Use in Lighting Products.
- H. OSHA 29CFR1910.7 luminaires shall be listed by nationally recognized testing laboratory approved by United Stated Department of Labor, Occupational Safety and Health Administration (OSHA).
- I. ANSI C82.11 Performance requirement for high frequency ballasts.
- J. ANSI C62.41 Recommended practice in low power circuits.
- K. IEC 61347-1 General and safety requirements for lamp control gear.
- L. IEC 61347-2-13 Particular requirements for electronic control gear for LED modules.
- M. IEC 62384 DC or AC supplied electronic control gear for LED modules performance requirements.

- N. IEC 61000-3-2 Harmonic current emissions.
- O. IEC 61547 EMC immunity requirements.
- P. IEC 62386-101/102/207 Digital addressable lighting interface (DALI).
- Q. Federal Communications Commission (FCC) rules Part 15 Class B: Radio Frequency Devices.
 - 1. Commercial rated
- R. Entertainment Services and Technology Association
 - 1. ESTA E1.3 Entertainment Technology Lighting Control System 0 to 10V Analog Control Protocol.

1.4 DEFINITIONS:

CALIPER	DOE Commercially Available LED Product Evaluation and Reporting program for the testing and monitoring of commercially available LED Luminaires and lights.
CCT	Correlated Color Temperature: The temperature in units of kelvin of a blackbody whose chromaticity most nearly resembles that of the light source in question.
cd	Candela: SI Unit of luminous intensity, equal to 1 lumen per steradian (lm/sr).
Chromaticity	The property of color of light defined by the dominant or complementary wavelength and purity aspects of the color taken together.
CRI	Color Rendering Index – measure of the degree of color shift of reference objects when illuminated by the light source as compared to a reference source of comparable color temperature.
fc	Footcandle: Unit of illuminance, equal to 1 lm/ft ² .
L80	The extrapolated life in hours of the luminaire when the luminous output depreciates 20 percent from initial values.
LED	Liaht Emittina Diode
METS	Material Engineering and Testing Services of the Translab
METS MacAdam	Material Engineering and Testing Services of the Translab Shape on the CIE chromaticity diagram that illustrates how much one can "stray" from the target before perceiving a difference from the target color.
METS MacAdam NEMA	Material Engineering and Testing Services of the Translab Shape on the CIE chromaticity diagram that illustrates how much one can "stray" from the target before perceiving a difference from the target color. National Electrical Manufacturers Association
METS MacAdam NEMA NRTL	Material Engineering and Testing Services of the Translab Shape on the CIE chromaticity diagram that illustrates how much one can "stray" from the target before perceiving a difference from the target color. National Electrical Manufacturers Association Nationally Recognized Testing Laboratory
METS MacAdam NEMA NRTL NVLAP	Material Engineering and Testing Services of the Translab Shape on the CIE chromaticity diagram that illustrates how much one can "stray" from the target before perceiving a difference from the target color. National Electrical Manufacturers Association Nationally Recognized Testing Laboratory National Voluntary Laboratory Accreditation Program - A program under the US DOE to accredit independent testing laboratories to qualify.
METS MacAdam NEMA NRTL NVLAP PF	Material Engineering and Testing Services of the Translab Shape on the CIE chromaticity diagram that illustrates how much one can "stray" from the target before perceiving a difference from the target color. National Electrical Manufacturers Association Nationally Recognized Testing Laboratory National Voluntary Laboratory Accreditation Program - A program under the US DOE to accredit independent testing laboratories to qualify. Power Factor - The ratio of the real power component to the total (complex) power component.

- RoHS Compliance aims to restrict certain dangerous substances commonly used in electronic equipment, including Lead, Cadmium, Mercury and others.
- SPD Surge Protection Device A subsystem or component(s) that can protect the unit against short duration voltage and current surges.
- SSL Solid State Lighting
- THD Total Harmonic Distortion The amount of higher frequency power on the power line.

1.5 SUBMITTALS

- A. Refer to Section 01330 Submittal Procedures, for submittal requirements
- B. Shop drawings: Clearly indicate luminaire type, name of the job, and Architect. Contractor shall submit all luminaire, driver and integral controls shop drawings at one time, in one package. Re-submittals shall include all luminaire, driver and integral controls previously rejected or requiring further information. Specialty SSL, custom, or modified fixtures may be submitted as a separate package.
- C. Shop Drawings: Reproductions of the contract drawings are not acceptable as shop drawings.
- D. Product Data: Provide dimensions, ratings and specific catalog number and identification of items and accessories and performance data.
- E. Shop Drawings: Indicate any components for each luminaire that are not a standard product of the manufacturer.
- F. Wiring Diagrams as needed for special operation or interaction with other system(s)
- G. Photometric Data: Where indicated below or for substitutions, supply complete photometric data for the fixture, including optical performance, rendered by NVLAP approved laboratory developed according to the methods of the Illuminating Engineering Society of North America. Submit electronically, in IESNA LM-63 standard format. Types XX, YY.
- H. Submit photometric data for all substitute luminaries. Photometric reports are required from specified manufacturer unless noted in 1.5.7 above.
- I. Specification Sheets: If lacking sufficient detail to indicate compliance with contract documents, standard specification sheets will not be accepted. This includes, but is not limited to, luminaire type designation, manufacturer's complete catalog number, voltage, LED type, CCT, CRI, specific driver information, system efficacy, L80 life rating, and any modifications necessary to meet the requirements of the contract documents.
- J. Substitutions shall include complete photometric data as outlined in paragraph 1.5.7 above, and point by point calculations for the specific conditions on the project. Samples shall be required for consideration of any substitutions and must be submitted in accordance with the terms outlined in paragraph 1.5.11 below.
- K. Working Samples of all substitutions: Samples shall be 120 volt with cord and plug attached, and shall include specified LEDs and all modifications necessary to meet the requirements specified in the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Approved Manufacturers: Provide products of firms regularly engaged in the manufacture of recessed lighting fixtures and components of types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years. The manufacturer of the lighting fixtures and components shall comply with the provisions of the appropriate code and standards. All fixtures shall be pretested before shipping.
- B. Conformance: Fixtures shall be manufactured in strict accordance with the Contract Drawings and Specifications.
- C. Codes: Materials and installation shall be in accordance with the latest revision of the National Electrical Code and any applicable Federal, State, and local codes and regulations.
- D. UL or CSA US Listing All fixtures shall be manufactured in strict accordance with the appropriate and current requirements of the "Standards for Safety" to UL 8750 or others as they may be applicable. A listing shall be provided for each fixture type, and the appropriate label or labels shall be affixed to each fixture in a position concealing it from normal view.
- E. Luminaire shall be DLC Certified (Design Lights Consortium).
- F. Specifications and scale drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work.
- G. Base Bid Manufacturers: Are listed on fixture schedule and specification. Manufacturers listed without accompanying catalog numbers are responsible for meeting the quality standards and photometric distribution set by the specified product.
- H. Alternate Manufacturers: Identification by means of manufacturer's names and catalog numbers is to establish basic features, quality and performance standards. Any substitutions must meet or exceed these standards.
- I. Luminaire shall carry the Lighting Facts label, verified based on LM-79 test reports.
- 2.2 LUMINAIRES TYPE XX, YY Linear Pendant
 - A. Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply) and integral controls as per this specification.
 - B. Each luminaire shall be designed to operate at an average operating temperature of 25°C.
 - C. The operating temperature range shall be 0° C to +25°C.
 - D. Each luminaire shall meet all parameters of this specification throughout the minimum operational life of 50,000 hours when operated at the average operating temperature (see 2.2.2).
 - E. Luminaire Construction:
 - 1. Luminaire housing to have no visible welding, screws, springs, hooks, rivets, bare LEDs, or plastic supports.
 - 2. The luminaire shall be a single, self-contained device, not requiring on-site assembly for installation. The power supply and circuit board for the luminaire shall be integral to the unit.
 - 3. Luminaires shall be fabricated from post painted cold rolled 18 GA steel and shall be a

rigid structure with die cast end caps, mechanically attached with no visible fasteners. Luminaire may be mounted and wired in continuous rows.

- 4. Finish: Polyester powder coat painted in white, black or painted aluminum as per specification. (Specifier to edit for color selection or custom color with color reference number).
- 5. Luminaire lengths of 4' or 8' shall be joined to create a continuous run using internal joiners as shown on drawings.
- 6. Optics Engineered optical systems of high performance lens, diffusers and metal reflectors.
- 7. Lens shall be single clear diffuser with advanced optical film and shall provide LED concealment and even illumination across the diffuser.
- 8. Polymeric materials (if used) of enclosures containing either the power supply or electronic components of the luminaire shall be made of UL94VO flame retardant materials. Luminaire lenses are excluded from this requirement.
- 9. Suspension shall be aircraft wire with total suspension length as specified. Cable to be field adjustable.
- 10. The assembly and manufacturing process for the SSL luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration and prevent light leaks at all visible joints.
- F. LED Sources
 - 1. LEDs shall be manufactured by Nichia.
 - 2. Lumen Output minimum initial delivered lumen output of the luminaire shall be as follows for the lumens exiting the luminaire in the 0-360 degree zone as measured by IESNA Standard LM-79-08 in an accredited lab. Exact tested lumen output shall be clearly noted on the shop drawings.
 - 3. Individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the all LEDs within the luminaire.
 - 4. LED Boards shall be suitable for field maintenance and have plug-in connectors. LED boards shall be upgradable.
 - 5. Light Color/Quality
 - a. Correlated Color Temperature (CCT) range as per specification, between 3000K, to 5000K shall be correlated to chromaticity as defined by the absolute (X, Y) coordinates on the 2-D CIE chromaticity chart.
 - b. Color shift over 6,000 hours shall be <0.007 change in u' v' as demonstrated in IES LM80 report.
 - c. The Color Rendition Index (CRI) shall be 80 or greater.
 - d. LED boards to be tested for color consistency and shall be within a space of 2.5 MacAdam ellipses on the CIE chromaticity chart.
- G. Power Supply and Drive
 - 1. Driver: Acceptable manufacturer: eldoLED
 - 2. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
 - 3. Driver shall be UL Recognized under the component program and shall be modular for simple field replacement. Drivers that do not meet these requirements will not be accepted.
 - 4. Electrical characteristics: 120 277 volt, UL Listed, CSA Certified, Sound Rated A+. Driver shall be > 80% efficient at full load across all input voltages. Input wires shall be 18AWG solid copper minimum.
 - 5. Dimming: Driver shall be suitable for full-range dimming. LED dimming shall be equal in range and quality to a commercial grade incandescent dimmer. Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, inaudible in 26db environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial

environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval. The luminaire shall be capable of continuous dimming without perceivable flicker over a range of 100 percent to 0.1 percent of rated lumen output with a smooth shut off function.

- a. Dimming shall be controlled by a 0-10V signal.
- b. Driver shall include ability to provide no light output when the analog control signal drops below 0.5V, or the DALI/DMX digital signal calls for light to be extinguished and shall consume 0.5 watts or less in this standby. Control deadband between .5 and .65V shall be included to allow for voltage variation of incoming signal without causing noticeable variation in fixture to fixture output.
- c. Driver shall be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels.
- d. Driver must be capable of 20 bit dimming resolution for white light LED driver.
- e. Drivers shall track evenly across multiple fixtures at all light levels, and shall have an input signal to output light level that allows smooth adjustment over the entire dimming range.
- 6. Flicker: Driver and luminaire electronics shall deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100-0.1 percent luminaire shall have:
 - a. Less than 1 percent flicker index at frequencies below 120 Hz.
 - b. Less than 12 percent flicker index at 120 Hz, and shall not increase at greater than 0.1 percent per Hz to a maximum of 80 percent flicker index at 800Hz.
- 7. Driver disconnect shall be provided where required to comply with codes.
- 8. The electronics/power supply enclosure shall be internal to the SSL luminaire and be accessible per UL requirements.
- 9. The surge protection which resides within the driver shall protect the luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C64.41 2002 for Location Category A, where failure does not mean a momentary loss of light during the transient event.
- H. Electrical
 - 1. Power Consumption: Maximum power consumption, +/- 5% when operating between 120 277V (or 346V) shall be as follows:
 - a. Type $XX 8\frac{1}{4}$ x 4' 30 watts and 45 watts nominal
 - b. Type YY 8 $\frac{1}{4}$ " x 8' 60 watts and 90 watts nominal
 - Operation Voltage The luminaire shall operate from a 60 HZ ±3 HZ AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage of (+/- 10%) shall have no visible effect on the luminous output.
 - 3. Power Factor: The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.
 - 4. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent at any standard input voltage and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD.
 - 5. Surge Suppression: The luminaire shall include surge protection to withstand high repetition noise and other interference. Withstand up to a 1,000 volt surge without impairment of performance as defined by ANSI C62.41 Category A.
 - 6. In Rush Current: Meet or exceed NEMA 410 driver inrush standard of 430 Amps per 10 Amps load with a maximum of 370 Amps2 seconds.
 - 7. RF Interference: The luminaire and associated on-board circuitry must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 Non-Consumer requirements for EMI/RFI emissions.
 - 8. Driver must support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:
 - a. Adjustment of forward LED voltage, supporting 3V through 60V.

- b. Adjustment of LED current from 200mA to 1.05A at the 100 percent control input point in increments of 1mA.
- c. Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000 hour design life of the system, and deliver up to 20 percent energy savings early in the life cycle.
- 9. Electrical connections between normal power and driver must be modular utilizing a snap fit connector. All electrical components must be easily accessible after installation and be replaceable without lowering the luminaire.
- 10. All electrical components shall be RoHS compliant.
- I. Photometric Requirements
 - 1. Luminaire performance shall be tested as described herein.
 - 2. Luminaire performance shall be judged against the specified minimum illuminance in the specified pattern for a particular application.
 - 3. Luminaire lighting performance shall be adjusted (depreciated) for the minimum life expectancy (Section 2.2.4).
 - a. The performance shall be adjusted (depreciated) by using the LED manufacturer's data or the data from the IESNA Standard TM-21 test report, which ever one results in a higher level of lumen depreciation.
 - b. The ratio of the peak-to-zenith maximum candela ratios shall be 1.94:1 @ 127.5 degrees.
 - c. The luminaire may be determined to be compliant photometrically, if:
 - 1) The initial minimum illuminance level is achieved in 100% of the area of the specified lighting pattern.
 - 2) The measurements shall be calibrated to standard photopic calibrations.
- J. Thermal Management
 - 1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life (Section 2.2.7 (c)).
 - 2. The LED manufacturer's maximum junction temperature for the expected life (Section 2.2.7 (c)) shall not be exceeded at the average operating ambient (Section 2.2.2).
 - 3. The LED manufacturer's maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient temperature (Section 2.2.3).
 - 4. The luminaire shall have a UL or CSA rating.
 - 5. The Driver manufacturer's maximum case temperature shall not be exceeded at the maximum operating ambient temperature. Thermal management shall be passive by design. The use of fans or other mechanical cooling devices shall not be allowed.
- K. Optics
 - 1. Optics shall consist of high performance advanced optical film, diffuser, and metal reflector.
 - 2. Optics shall eliminate source image.
 - a. Each luminaire shall be equipped with one (1) digital RJ45 port and interface with other digital control equipment where specified.
 - b. Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.
 - c. Digital manual wall control shall integrate with the SSL luminaire via CAT5E cable and be self-commissioning.
 - d. Digital occupancy sensor shall integrate with the SSL luminaire via CAT5E cable and be self-commissioning.
 - e. Digital photocell shall integrate with the SSL luminaire via CAT5E cable and be self-commissioning.

- f. Integral Daylight Dimming or Daylighting Dimming with Occupancy Detections sensors shall be provided as per specification. Sensor shall be designed to be low profile to minimize appearance in luminaire.
- g. Lumen Management: The luminaire shall be capable of continuously monitoring system performance to allow for constant lumen management / compensation function. Lumen output to be maintained at 80% for life of the luminaire, initial input to be 80% of rated input watts and climb to rated watts by end of rated life. Energy savings shall be 20% initially and 10% over the rated life of the luminaire.
- h. Each luminaire shall be supplied with a unique network address. This address shall be printed on two identification labels. One label shall be permanently affixed to the luminaire and one label shall be easily removed for network control commissioning purposes. Both labels shall be in a location which is easily accessible by the installing contractor.
 - 1) Control Input:
 - 2) 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers:
 - a) Must meet IEC 60929 Annex E for General White Lighting LED drivers
 - b) Must meet ESTA E1.3 for RGBW LED drivers
 - 3) Digital (DALI Low Voltage Controlled) Dimming Drivers:
 - a) Must meet IEC 62386
- L. Luminaire Identification
 - 1. Each luminaire shall have the manufacturer's name, trademark, model number, serial number, date of manufacture (month-year), and lot number as identification permanently marked inside each unit and the outside of each packaging box.
 - 2. The following operating characteristics shall be permanently marked inside each unit: rated voltage and rated power in Watts and Volt-Ampere.
- M. Quality Assurance
 - The luminaires shall be manufactured in accordance with a manufacturer quality assurance (QA) program. The QA program shall include two types of quality assurance: (1) design quality assurance and (2) production quality assurance. The production quality assurance shall include statistically controlled routine tests to ensure minimum performance levels of the modules built to meet this specification. These tests shall include: CCT, CRI, Lumen output, and wattage. Tests shall be recorded, analyzed and maintained for future reference.
 - 2. QA process and test results documentation shall be kept on file for a minimum period of seven years.
 - 3. LED luminaire designs not satisfying design qualification testing and the production quality assurance testing performance requirements described below shall not be labeled, advertised, or sold as conforming to this specification.
- N. Design Qualification Testing
 - 1. Design Qualification Testing shall be performed by a National Voluntary Laboratory Accreditation Program (NVLAP) testing facility. Such testing may be performed by the manufacturer or an independent testing lab hired by the manufacturer on new luminaire designs and when a major design change has been implemented on an existing design. A major design change is defined as a design change (electrical or physical), which changes any of the performance characteristics of the luminaire, results in a different circuit configuration for the power supply, or changes the layout of the individual LEDs in the module.
 - 2. A quantity of two units for each design shall be submitted for Design Qualification Testing.
 - 3. Product submittals shall be accompanied by product specification sheets or other documentation that includes the designed parameters as detailed in this specification.

These parameters include (but are not limited to):

- a. Maximum power in Watts.
- b. L80 in hours, when extrapolated for the worse case operating temperature (section 2.2.3). TM21 report shall be submitted to demonstrate this.
- c. Product submittals shall be accompanied by performance data that is derived in accordance with appropriate IESNA testing standards and tested in a laboratory that is NVLAP accredited for Energy Efficient Lighting Products.
- 4. Luminaire shall be tested per IESNA LM 79-08.

2.3 WARRANTY

- A. The manufacturer shall provide a single source, 5 year limited warranty against loss of performance and defects in materials and workmanship for all components of the luminaire. Warranty is from the time of acceptance of the Luminaires. All warranty documentation shall be provided to customer prior to the first shipment.
- B. Provide manufacturer's warranty covering 5 years on drivers from date of purchase.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 501.
- B. Fixture to suspend by aircraft wire to the mounting height specified. Adjustable cable gripper shall be provided as per specification. Luminaires shall be mounted straight and plumb. Contractor shall verify ceiling type and shall obtain all required mounting hardware for specific ceiling type.
- C. Canopies shall be provided.
- D. Cord Managers shall be provided to ensure the power cords and CAT5E cables can be coupled with the aircraft cables creating one line from the fixture to the ceiling.
- E. Install all required hardware and mounting brackets to secure luminaires to structure per local code requirements.
- F. Bond luminaires and metal accessories to branch circuit equipment grounding conductor.

3.2 FIELD QUALITY CONTROL

- A. Perform field inspection, testing, and adjusting in accordance with Section 01400.
- B. Operate each luminaire after installation and connection. Inspect for improper connections and operation.
- C. Test and calibrate all controls associated with luminaires, i.e. integral photo cells and occupancy sensors.

3.3 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from lens and enclosures

- 1. For cleaning acrylic lenses or diffusers, use a feather duster or dry cotton cheesecloth to rid the lens/diffuser of any minor dust. For fingerprints, smudges, or other dirt present, use an ammonia-based cleaner (such as Windex) and wipe carefully with cotton cheesecloth (so as to avoid injury from any prismatic texture of the lens).
- 2. Contractor shall replace the lens if Job site contamination cannot be removed using the above recommendations.
- C. Clean photometric control surfaces as recommended by manufacturer.

3.4 CLOSEOUT ACTIVITIES

A. Replace any luminaire components or associated controls which are not functioning per specifications.

END OF SECTION
SECTION 16530

EMERGENCY LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes emergency exit signs.
- B. Related Sections:
 - 1. Section 16060 Grounding and Bonding for Electrical Systems.
 - 2. Section 16128 Raceway and Boxes for Electrical Systems.
 - 3. Section 16510 Interior Luminaires: Exit signs.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
 1. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SYSTEM DESCRIPTION

A. Emergency lighting to comply with requirements.

1.4 SUBMITTALS

- A. Section 01330 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit dimensions, ratings, and performance data.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 MAINTENANCE MATERIALS

- A. Section 01700 Execution Requirements: Spare parts and maintenance products.
- B. Furnish one < 100 replacement lamps for each lamp installed.
- C. Furnish one < 100 replacement battery for each battery type and size.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 EXIT SIGNS

- A. Manufacturers:
 - 1. Cooper Industries Sure-Lites
 - 2. Hubble Inc, Dual-Lite

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- 3. Lithonia Lighting
- 4. Substitutions: Section 01600 Product Requirements.
- B. Product Description: Exit sign fixture.
- C. Housing: Extruded aluminum.
- D. Face: Aluminum stencil face with red letters.
- E. Directional Arrows: Universal type for field adjustment.
- F. Mounting: Universal, for field selection.
- G. Battery: 6 volt, nickel-cadmium type, with 1.5 hour capacity.
- H. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
- I. Lamps: LED, 5 W per side, maximum.
- J. Input Voltage: 120/277 volts.

PART 4 - EXECUTION

- 4.1 EXISTING WORK
 - A. Disconnect and remove abandoned emergency lighting units, exit signs, lamps, and accessories.
 - B. Extend existing emergency lighting and exit sign installations using materials and methods compatible with existing installations, or as specified.
 - C. Clean and repair existing emergency lighting units and exit signs remaining or are to be reinstalled.

4.2 INSTALLATION

- A. Install suspended exit signs using pendants supported from swivel hangers. Install pendant length required to suspend sign at indicated height.
- B. Install surface-mounted emergency exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- C. Install wall-mounted exit signs at height as indicated on Drawings.
- D. Install accessories furnished with each and exit sign.
- E. Connect emergency and exit signs to branch circuit outlets provided in Section 16128 as indicated on Drawings.
- F. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within unit.
- G. Install specified lamps in each emergency lighting unit and exit sign.

H. Ground and bond emergency lighting units and exit signs in accordance with Section 16060.

4.3 FIELD QUALITY CONTROL

- A. Section 01700 Execution Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Operate each unit after installation and connection. Inspect for proper connection and operation.

4.4 ADJUSTING

- A. Section 01700 Execution Requirements: Testing, adjusting, and balancing.
- B. Aim and adjust lamp fixtures in the field conditions.
- C. Position exit sign directional arrows as indicated on Drawings.
- 4.5 PROTECTION OF FINISHED WORK
 - A. Section 01700 Execution Requirements: Protecting finished work.
 - B. Relamp exit signs having failed lamps at Substantial Completion.

END OF SECTION

EMERGENCY LIGHTING

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1. PART I - GENERAL

1.0. PURPOSE

The intent of this document is to provide a standard specification that will be used for all UNLV facilities requiring cable installation. This document provides the minimum performance criteria for the components and sub-systems comprising a complete cabling system that shall accommodate UNLV's requirements in excess of ten years.

Product specifications, general design considerations, and installation guidelines are provided in this written document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types for a specific UNLV facility will be provided as an attachment to a Request for Proposal. If the bid documents are in conflict, the Request for Proposal specification shall take precedence. The successful vendor shall meet or exceed all requirements for the cabling system described in this document.

This specification is intended to provide general design guidelines for new construction, and performance criteria for additions/renovations to existing facilities. Since all new construction will have telephone/data communication service raceways provided by an electrical subcontractor under the general contract, the specifications included in this document are intended as supplemental information to insure an acceptable, effective installation.

1.1. CONTRACTOR QUALIFICATIONS

Contractor must possess a valid State of Nevada Contractor's License and have successfully performed at least three projects of low voltage cable installation with similar size and work scope, within two years of the date of the job they are bidding on. Proof of performance shall be in the form of reference sheets which shall include a brief description of the project, the start and end dates, and contact information. For projects that require a Request for Proposal this information will be required as part of the submittal. See section 1.3. For work that does not require a Request for Proposal, this information should be available upon request.

All contractor personnel who will be performing work on this project shall have been trained on the work they will be performing. They shall have been trained on the Contractor's company policies with respect to personnel safety, telecommunications industry cabling quality and neatness standards, and use of Construction Standard Institute (CSI)-standard specifications and drawings.

Contractor, at all times during performance and until work is completed and accepted, shall have on the premises a competent supervisor, satisfactory to the Customer and with authority to act for the Contractor. The supervisor must be a BICSI certified Installer and BICSI member in good standing.

Contractor must have a current BICSI certified Registered Communications Distribution Designer (RCDD) on staff as a full-time employee as a requirement to bidding and performing awarded work. For projects that require a Request for Proposal the RCDD certificate and BICSI member number will be required as part of the submittal. See section 1.3. For work that does not require a Request for Proposal, this information should be available upon request.

For jobs that require more than 24 data connections, weekly inspections and approval of all work performed shall be conducted by the contractor's RCDD certified employee.

Contractor must provide at least one lead technician on site at all times during project who is a BICSI certified installer and a BICSI member in good standing. For projects that require a Request for Proposal a copy of certificate and BICSI member number will be required as part of the submittal. See section 1.3. For work that does not require a Request for Proposal, this information should be available upon request must be provided with bidding documents.

1.2. APPLICABLE REGULATIONS

A. RELATED DOCUMENTS

Equipment and material shall be Underwriter's Laboratories listed and labeled. The latest editions of the following standards are minimum requirements. If a conflict exists between applicable documents, then the order in the list below shall dictate the order of precedence in resolving conflicts. This order of precedence shall be maintained unless a lesser order document has been adopted as code by a local, state or federal entity, and is therefore enforceable as law by a local, state, or federal inspection agency.

- 1. ANSI/TIA-569-C Commercial Building Standard for Telecommunications Pathways and Spaces
- 2. ANSI/TIA 568-C.0 Generic Telecommunications Cabling for Customer Premises
- 3. ANSI/TIA-568-C.1 Commercial Building Telecommunications Cabling Standard
- 4. ANSI/TIA-568-C.2 Balanced Twisted-Pair TelecommunicationsCabling and Components Standard
- 5. ANSI/TIA-568-C.3 Optical Fiber Cabling Components
- 6. ANSI/TIA-606-B Administration Standard for the Telecommunications Infrastructure of Commercial Building
- 7. ANSI/TIA-607-B Commercial Building Grounding and Bonding Requirements for Telecommunications
- 8. ANSI/TIA-1152 Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling National Electrical Manufacturers Association (NEMA)
- 9. National Electrical Code, latest revision (NEC)
- 10. National Fire Protection Agency (NFPA) 70
- 11. Local, State and Federal Codes including Nevada Revised Statute (NRS) 278.583
- 12. Nevada State Public Works Board Adopted Standards
- 13. UL 497 Protectors
- 14. UL 1459 Standard for Safety for Telephone Equipment
- 15. UL 1863 Standard for Safety for Communications Circuit Accessories
- 16. UL 2024 Standard for Safety for Optical Fiber Cable Raceway
- 17. UL 723 Standard for Safety for Surface Burning Characteristics of Building Materials
- 18. UL 1581 Standard for Safety for Reference Standard for Wires, Cables and Flexible Cords
- 19. TIA SP-4195
- 20. National Electrical Safety Code (NESC)
- 21. ANSI/EIA 310D

1.3. SUBMITTAL

For jobs that require submittals, the Contractor shall furnish the following in a single consolidated submittal with an Approval copy to the Customer:

- 1. Contractor's license number and proof of qualifications.
- 2. A copy of the RCDD certificate and BICSI member number as described in the above Contractor Qualifications section.

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- 3. A copy of the BICSI certificate and the BICSI member number of the lead technician as described in the above Contractor Qualifications section.
- 4. A copy of the BICSI certificate and the BICSI member number of the supervisor as described in the above Contractor Qualifications section.
- 5. For all Category 6A and 6 installation technicians, provide the training certificates with a brief description of the training courses associated with each certificate.
- 6. Reference sheets which provide three references. Each reference shall include a brief description of the project, the start and end dates, and contact information.
- 7. A copy of a valid manufacturer certified installer certification.
- 8. The make and model of the materials to be used.

1.4. DESIGN REQUIREMENTS

Work must conform to the design requirement for each identified element.

B. BUILDING SERVICE

Plans for all new buildings shall include a design for extending the campus voice, data and video networks to the building. Consistent with this design, network trunks shall be extended as a part of the initial construction and equipment shall be installed to provide connection to the building. Every building, regardless of size, shall be constructed to allow for an air-blown fiber tube-cell conduit to enter through individual 4" conduits from the campus underground plant from two diverse locations. Exact air-blown fiber tube-cell conduit size will be determined by Network Development and Engineering on project by project basis. Voice cables (minimum 50 pair) to enter from the campus underground plant from one location. In addition, every building shall be equipped with at least two empty 4" conduits to the campus underground plant for later use by UNLV after installation of all voice and data cables. All raceways to have 880 lb. nylon pull strings installed. All new service entrance conduits shall be a minimum 4" trade size and of sufficient number to provide 50% growth capacity, and will terminate 4" above finished floor in the MDF (main distribution frame) room inside the building.

1. Service – Data

Data communication service to each building shall consist of a minimum of 24 strands of 50/125-micron multi-mode fiber and 72 strands of 9.0/125-micron single-mode fiber and terminated at two separate major distribution locations on campus as determined by UNLV Network Development and Engineering. Fiber optic cable is to be contained in its own air-blown fiber tube-cell conduit. Multi-mode and single-mode fiber is to be terminated with LC style connectors, UPC. Multi-mode and Single-mode terminated in separate rack mounted fiber optic enclosures.

Contractor will install an air-blown fiber distribution unit in all MDF and IDF locations. Each fiber optic enclosure must be labeled with building, IDF room number and fiber enclosure identifier of opposing end. Patch panels to be mounted in such a manner as to allow the maximum usage of each rack. Appropriate wire management, determined by consultation with Network Development and Engineering and with regards to building design, shall be installed. Service loops of fiber-optic cable will be coiled, to meet manufacturer specifications, at both termination points. Complete IDF room design, including rack layout, power requirements, cable management will be provided by UNLV Network Development and Engineering.

2. Service – Voice

Voice communication service to each building shall consist of a minimum of one 24 AWG, solid annealed copper, 50 pair twisted cable. Cable to enter building through a

separate, dedicated conduit. Cable to be terminated patch panel(s) in data rack(s). One pair per RJ-45 block, terminated on blue/white-blue. Lightning protection to be provided as required per design specifications and/or applicable codes and regulations.

C. SERVICE ENTRIES

Elements of the service entry facilities design are to include type, size, gauge, and insulation of distribution cables. Every copper cable shall be bonded and grounded for lightning protection per NEC 800-30A at both terminations using solid-state 5-pin protectors, 50 to 100 volt range.

Building entry conduit shall allow for 50% growth and have a minimum of four 4" conduits from manhole to MDF room.

D. MANHOLES

All manholes shall be at minimum 4' by 4' by 4' and encased in concrete. All cable is to have service loops and be racked and mounted. Each manhole will have drainage holes and be engineered so water will not accumulate. Top of manholes are to be flush with paved areas, or 6" above finished grade in landscaped areas.

E. CABLE SPLICING

Copper cable splicing is only allowed where previously approved by UNLV Network Development and Engineering. Fiber-optic cable will only be spliced at the termination point. Fiber-optic splicing must be fusion based with two fibers optic strands of the exact make and model on each end using factory terminated connectors on pigtails. Splicing is not acceptable outside of Tele/Data rooms. Epoxy based splices shall not be acceptable. The following cable splicing techniques and materials for copper cable shall be utilized:

1. Preparation for Splices

All copper cables shall be thoroughly cleaned and scuffed in a manner to insure a good mechanical bond when splicing. 3M Scotchcast 4435 nonconductive aluminum oxide abrasive strip, or UNLV approved equal shall be used. All cable shall be thoroughly cleaned with a non-toxic solvent, 3M Scotchcast 4414 or 4415 or UNLV approved equal.

2. Splicing requirements

- a. No splice cases will be permitted in cable trays.
- b. All splice closures for use on underground non-pressurized systems shall be manufactured of clear, self-extinguishing, tongue and groove fitting PVC.
- c. End caps must be tapered and flexible and be capable of separate cable entries.
- d. Rigid bonding and strain relief bars must be an integral part of the finished closure.
- e. Re-enterable, polyurethane compound shall be used.
- f. All cable splices must be tagged or marked showing the cable number and pair count spliced. Markings may be placed on the splice closure or on both the in and out cables.
- g. Supports: All cable splices shall be supported by a minimum of two cable hooks. Horizontal racking for support may utilize 3M Brand RC-100 rack adapters, manhole racks, or University approved equivalent.
- h. Closures: 3M splice closures or University approved closures will be used for splicing throughout the system.

i. Protection: All cable splices must be protected from damage at sheath openings by mechanically protecting all conductors utilizing 3M Scotchcast Pair Saver 4458 or approved equivalent.

F. BUILDING VOICE AND DATA TERMINAL ROOMS

All new building structures shall have minimum one primary Data communication room in which the outside cable terminates, henceforth referred to as the Main Distribution Facility (MDF). Each building may have additional data rooms for end wiring, henceforth referred to as Intermediate Distribution Facilities (IDFs).

1. Main Distribution Facility (MDF) Specifications

- a. The MDFs shall **not contain any equipment not specified by UNLV Network Development and Engineering**. This includes, but is not limited to, Marlok equipment, transformers, sinks, fire or building alarm equipment. They shall be kept clear of all other equipment.
- b. Each MDF will be provided with isolated grounds, including a 6' vertical earth ground, and an isolated electrical panel with 200-amp service.
- c. Each MDF will have four 20 amp, 110 V.A.C. outlets, terminated with NEMA 5-20Rs, two 30 amp 208 V.A.C. outlets, terminated with NEMA L6-30Rs, and two 20 amp NEMA L6-20Rs. All outlets will be serviced by the emergency power system and colored orange or otherwise marked as such. All outlets will be positioned within 4 feet of the rear of the provided racks, near floor level.
- d. All MDFs shall be accessible only from inside the building. No outside entrances are permitted. All doors between the outside and the MDF must be at least 36" wide and 80" high.
- e. Rooms will be rectangular or square, have a minimum clearance height of eight feet without obstructions (sprinklers, etc.), be at least 14' x 10', and not have false floors or ceilings.
- f. No exposed water or gas pipes shall enter in or run through the main terminal room or data room. No drains, ducts or clean-outs will be permitted.
- g. A separate HVAC thermostat control will be installed for all MDF rooms, and shall be air conditioned with separate zone or air conditioning unit 24 hours a day, seven days a week. A positive pressure shall be maintained with a minimum of one air change per hour.
- h. All MDFs shall be secured using a Marlock card swipe reader and striker.
- i. All MDFs shall be provisioned with at least one standard data rack, Panduit R4PCN, bolted to the floor. These rack(s) shall be placed side-by-side, with vertical cable management, Panduit part# WMPVHC45E in between and on both sides. The racks must have a minimum of 36" of clearance front and back and at least 18" on both sides. OIT provided room drawings must be followed.
- j. Ladder rack shall be provided and installed sufficient to secure the equipment rack to the adjacent wall(s) as determined at installation and to provide support for incoming cables.
- k. A minimum of two walls must be covered by backboards as defined in Part II.
- I. Floor loading shall be designed to support a minimum of 1000 pounds of equipment per data rack provided.
- m. All other elements of room to be designed and provisioned per ANSI/EIA/TIA 569-C or better.

2. Intermediate Distribution Facilities (IDFs)

- a. The IDFs shall not contain any equipment not specified by UNLV Network Development and Engineering. This includes, but is not limited to, Marlok equipment, transformers, sinks, fire or building alarm equipment. They shall be kept as clear of all other equipment.
- b. Each IDF will be provided with isolated grounds, including a 6' vertical earth ground.
- c. Each IDF will have four 20 amp, 110 V.A.C. outlets, terminated with NEMA 5-20Rs and two 30 amp 208 V.A.C. outlets, terminated with NEMA L6-30Rs. All outlets will be serviced by the emergency power system and colored orange or otherwise marked as such. All outlets will be positioned within 4 feet of the rear of the provided racks, near floor level.
- d. All IDFs shall be accessible only from inside the building. No outside entrances are permitted. All doors between the outside and the IDF must be at least 36" wide and 80" high.
- e. Rooms will be rectangular or square, have a minimum clearance height of eight feet without obstructions (sprinklers, etc.), be at least 8' x 10', and not have false floors or ceilings.
- f. No exposed water or gas pipes shall enter in or run through the main terminal room or data room. No drains, ducts or clean-outs will be permitted.
- g. A separate HVAC thermostat control will be installed for all IDF rooms, and shall be air conditioned with separate own zone or air conditioning unit 24 hours a day, seven days a week. A positive pressure shall be maintained with a minimum of one air change per hour.
- h. All IDFs shall be secured using a Marlock card swipe reader and striker, the access of which is to be managed by the Network Operations Center.
- i. All IDFs shall be provisioned with at least one standard data rack, Panduit R4PCN, bolted to the floor. These rack(s) shall be placed side-by-side, with vertical cable management, Panduit part# WMPVHC45E in between and on both sides. The racks must have a minimum of 36" of clearance front and back and at least 18" on both sides. OIT provided room drawings must be followed.
- j. Enough rack space must be provided to terminate all fiber and copper, with associated cable management, plus 200%.
- k. Ladder rack shall be provided and installed sufficient to secure the equipment rack to the adjacent wall(s) as determined at installation and to provide support for incoming cables.
- I. A minimum of two walls must be covered by backboards as defined in Part II.
- m. Floor loading shall be designed to support a minimum of 1000 pounds of equipment per data rack provided.
- n. All other elements of room to be designed and provisioned per ANSI/EIA/TIA 569-C or better.

G. BUILDING INTERIORS

1. Underground Plant

a. The cables from the underground plant shall enter the building in a MDF room. Appropriate wire management shall be installed such as ladder racks, D-rings, and hook and loop tape so as not to exceed the acceptable cable bend radius.

2. Data Rooms

a. Additional IDF(s) shall be provided if necessary to prevent total length of data cable runs from exceeding 300 feet. Additional IDF rooms in multistory buildings shall be aligned vertically with the MDF room if possible.

3. Internal Backbones (Risers)

a. A minimum of two 4" conduits shall run between every IDF and the MDF within buildings. Pull strings shall be provided in every conduit. Data interconnections between each IDF and the MDF shall be via fiber optic cable containing a minimum of 24 strands of multi-mode and 24 strands of singlemode fiber, as defined in Part II. Fiber optic cable is to be contained inside airblown tube cell conduit. 12 Category 6 cables will be provided between every IDF and the MDF. Patch panels are to be mounted in such a manner as to allow the maximum usage of each rack.

4. Station Wiring

- a. Data Outlets
 - All outlets shall be constructed using single gang, 4-port faceplates, colored almond, or similar. All outlets shall have at least two network drops each.
- b. Copper Cabling
 - All drops shall be connected with blue network cabling from patch panels to each drop location and terminated on black data jack. Every cable shall be continuous and unspliced, with data cables attached to a single port in the patch panel at one end and to a single jack at the station end. All connections are to be done using the T568B wiring scheme. No cable run from patch panel to connection point may exceed 300 feet. All cabling must terminate in an IDF or MDF room on the same floor as the outlet unless building plans, certified by Network Development and Engineering, specify otherwise. Additional specifications for cabling, patch panels and data jacks as per specifications in Part II.
- c. Habitable Space Provisioning
 - Every habitable space shall be provisioned a minimum of one data outlet per person planned for the space or one outlet per 60 ft², whichever is greater. If the number of people planned for a space is not known, the 60 ft² guideline must be used.
- d. Non-habitable Space Provisioning
 - Every non-habitable space shall be provisioned with one data outlet every 500 ft², minimum of 1 per enclosed space. Exceptions may be granted for unusual circumstances by Network Development and Engineering, in writing.
- e. Labeling
 - The labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cable's origin and destination. Station identifiers shall match the corresponding patch panel port number for each drop. The drops will

be in consecutive order whenever possible. They shall increment from left to right then top to bottom on each individual faceplate. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. All label printing will be machine generated using indelible ink. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Faceplate labels will be the manufacturer's labels provided with the outlet assembly unless otherwise specified. As-builts & test results will be provided in .PDF. The labeling schema shall be as follows:

- All labels will be in the format of "310-306-1-24" Where "310" is the Station room number, "306" is the IDF, "1" is the Patch Panel identifier, and "24" is the port that the drop terminates to in the patch panel.
- Cable Wrap labels:

Wrap labels are required within 6 inches of the cable's termination point at both ends. Wrap labels will follow the format listed in this section, ie "310-306-1-24" Splitting this into two lines is acceptable in which case "310-306" would go on the first line and "1-24" would go on the second line. The font size will be the largest size that fits the required information but no smaller than 8 point font.

Station labels:

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The Station label will follow the format listed in this section. However, the top label include both top ports i.e "310-306-124,25". The first patch panel port number will always be the left face plate port and the second patch panel port number will always be the right face plate port. The bottom label will follow the same guidelines when used. When unused the label will be left blank. The font size will be the largest size that fits the required information but no smaller than 10 point font. See "Standard Outlet Configuration" in section 4

Data Room Patch Panel:

The patch panel identifier will be labeled by the installer on the left side of the patch panel in a place that is easily visible. Counting from the top of the rack down, the first installed patch panel will be identified with the number 1, the second with the number 2 and so on.

The patch panel port label will be in the format listed above "310306-1-24". Space limitations will require the label to be in two rows. The font size will be the largest size that fits the required information but no smaller than 8 point font. These labels should be center justified and located directly above the port they are labeling or in other manufacturer provided locations for port labels

5. Wireless – 802.11

Data cabling at wireless locations shall be terminated in electrical boxes that are mounted parallel to the ceiling, above the drop-ceiling grid panels. Two blue data cables shall be directly run from an IDF and will be terminated in data jacks. The jacks will be mounted in a faceplate and the faceplate will be mounted to the electrical box. These locations shall have a minimum clearance of 14" x 14" x 8". No cable run from IDF to connection point may exceed 300 feet.

6. Wireless Access Point Placement and Wireless Overlay for 802.11

Locations will be specified by consultation with UNLV Network Development and Engineering. The use of 3rd party professional RF Engineering design may be required under the special conditions. These conditions include but are not limited to the following:

- a. Any wireless bridge installation which requires rooftop cabling and mounting of wireless bridging hardware, antennae and masts.
- b. Installations which require access points to use antennae other than the standard dipole antennae
- c. The finished ceiling plan is exposed and the customer has specified that wireless hardware and antennae placement must be as limited as possible in order to meet aesthetic requirements of the building Consultation with UNLV Network Development and Engineering is required for all 802.11 Wireless infrastructure design.

7. Cable Trays

All cable trays must be UL rated and approved by UNLV Network Development and Engineering prior to their inclusion in specifications.

a. Supports

Cable trays for horizontal distribution cables, utilizing a center support hanger method to support the cable trays, will utilize threaded rods of not less than 1/2" in diameter.

b. Capacity

Cable trays shall be sized for a minimum growth of 50%.

8. Cable Installation

a. Copper

Installation is to meet or exceed ANSI/EIA/TIA 568-C and ANSI/EIA/TIA 569-C.

All terminations are to follow ANSI/EIA/TIA 568-B.

Completed installation is to be Certified Category 6 or 6A using the ANSI/EIA/TIA 568-C.2 testing standard or better. Test documents/results to be supplied to UNLV in .PDF and Linkware format. Completed installation is to be approved by UNLV Network Development and Engineering.

b. Fiber

Installation is to meet or exceed ANSI/EIA/TIA 568-C and ANSI/EIA/TIA 569-C. Fiber terminations will be completed using one of the following methods:

- No epoxy/no polish connectors
- Factory-terminated pigtails with fusion splicing

Multi-mode and single-mode will be terminated in separate rack mounted fiber optic enclosures.

Completed installation is to be certified using ANSI/EIA/TIA 568-C.3 testing standard or better. Test documents/results to be supplied to UNLV in .PDF and Linkware format. Completed installation is to be approved by UNLV Network Development and Engineering.

9. Pull and Splice Boxes

a. Location

Pull boxes must be installed in easily accessible locations. It is not permissible to locate a pull box in the ceiling for conduits larger than 2" in diameter. Conduits larger than 2" diameter, entering a box shall be routed down a wall or column and the box shall be installed accordingly.

All pull boxes shall be placed in a straight section of conduit. Align the corresponding conduits at each end. All boxes shall be properly and adequately secured. They are not to be supported by the conduits entering the box. Install boxes for station cabling immediately above the suspended ceiling.

b. Access

Provide boxes with a suitable cover.

H. GROUNDING

1. Regulations

All conduit and cable tray systems, supports, cabinets, equipment, etc., shall be properly grounded in accordance with the latest edition of the National Electrical Code (NEC) and all other applicable codes and regulations.

2. Installation Requirements

Provide all bonding wire and jumpers, grounding bushings, clamps, etc., required for complete grounding. Route ground conductors to provide the shortest, most direct path to the ground electrode system.

3. Grounded Connectors

Provide a separate grounding conductor, securely grounded on each side of all conduit and cable trays that do not provide a continuous, metallic path. Size shall be in accordance with the National Electrical Code (NEC). All ground connections will have clean contact surfaces, tinned and sweated while bolting. Avoid splices in bonding or grounding conductors. If splices are required they must be cad welded. Any grounding or bonding conductor that is run through a metallic conduit should be bonded to the conduit on both ends. Do not use a gas pipe as the grounding electrode.

4. IDF/MDF Room Grounding

All IDF and MDF rooms require an earth ground. Additionally, if the IDF/MDF room houses telecommunications switching or fiber remote equipment, single point of ground technology is required. This requires a separate ground bus in the service panel to the building transformer; otherwise power receptacles in the room must be isolated and grounded together with a number 6 AWG or larger copper wire.

2. PART II – PRODUCTS AND ACCEPTED MATERIALS

2.0. GENERAL

All material required for a complete installation shall be furnished by the Contractor unless otherwise specified by UNLV Planning and Construction Department

All materials provided by the Contractor must be new, free from defects and must meet the Customer's specifications. For projects that require a Request for Proposal, bidders shall submit the make and model of materials that will be used as part of their submittal. See section 1.3

All fixtures and hardware must be installed as per requirements detailed in this document. No custom items shall be used except as reviewed and approved by the Network Development and Engineering. The contractor shall be held financially responsible for any work or re-work required due to improper approval and /or acceptance of that work performed which differs from the construction documents.

All products shall be new, and brought to the job site in original manufacturer's packaging. Electrical components (including innerduct) shall bear the Underwriter's Laboratories label

All station cables shall be CMR Riser rated when entire cable runs are installed in conduit.

All station cables shall be CMP Plenum rated when any section of the cable run is not installed in conduit.

The Contractor shall inspect all products and materials prior to installation. Damaged cable or any other components failing to meet specifications shall not be used in installation.

2.1. BACKBOARDS

All backboards required in the IDF/MDF rooms shall be plywood, ³/₄", 4' by 8' sheets, grade A, treated on one side with fire resistant paint or material, installed with finished side exposed.

2.2. CABLE SPECIFICATIONS

A. WARRANTY

All copper and fiber cabling installations must be covered by an end-to-end manufacturer warranty of no less than 20 years. Vendors must be certified installers of the products they select for installation. The warranty is required to cover cabling, components, and performance. Parts and labor for replacements must also be included in the warranty

B. APPROVED CABLING MANUFACTURERS

1. Copper Installation:

Vendors may select from the following list of approved copper cabling manufacturers:

TE Connectivity Siemon Leviton Panduit

Products selected from these vendors must meet requirements detailed in this document.

a. New Building

All copper installations in new buildings on campus will be completed using products from a manufacturer on the approved list. All cabling and components will be certified Category 6A / Class Ea and will meet all requirements listed Section 2.2-C.

b. Existing Building

In cases where vendors install cabling in existing IDFs, installers shall use open ports on existing category 6 patch panels. The warranty requirement listed in section 2.1-A will apply to these installations. This will require vendors to be certified installers for the existing components in the IDF. If there are no open ports, not enough ports to complete the job, the existing patch panel is not category 6, or the installer is not a certified installer of the existing components, then after approval from Network Development and Engineering staff, the installer shall install products from a manufacturer on the approved list.

2. Fiber Installations:

Vendors may select from the following list of approved air-blown fiber cabling solution manufacturers where air-blown fiber is required:

Future Flex Air-Blown Network Solutions by Sumitomo Electric Lightwave eABF solutions by AFL

Vendors may select from the following list of approved fiber cabling solution manufacturers where Air-Blown Fiber is not required:

AFL TE Connectivity Siemon Leviton Panduit

Products selected from these vendors must meet requirements detailed in this document.

- a. Building to Building
 - All fiber installations for building to building interconnects will use airblown fiber solutions. Contractors shall install components from a manufacturer on the approved air-blown fiber manufacturer list.
- b. New Building
 - All fiber installations for new buildings on campus, including building to building interconnects and MDF to IDF connections will use air-blown fiber solutions. Contractors shall install components from a manufacturer on the approved air-blown fiber manufacturer list.
- c. Existing Building
 - All fiber installations for buildings with existing air-blown fiber infrastructure will be installed using use air-blown fiber solutions. Contractors shall install components from a manufacturer on the approved air-blown fiber manufacturer list.
 - All fiber installations for buildings without existing air-blown fiber infrastructure will be installed using traditional fiber cabling. Contractors shall install components from a manufacturer on the approved fiber manufacturer list.

C. DATA COPPER

All copper data cable for existing buildings will be Category 6, 4 pair, UTP (Unshielded Twisted Pair) and must meet or exceed ANSI/TIA and ISO Category 6 /Class E requirements. All copper data cable for new buildings will be Category 6A, 4 pair, UTP (Unshielded Twisted Pair) and must meet or exceed ANSI/TIA and ISO Category 6A /Class Ea requirements. Only materials from accepted manufactures in section 2.1.B will be installed. Cables will be rated as plenum or riser based on installation requirements.

D. EXTERIOR CABLE

All telephone cable that supports devices external of a building such as emergency phones use Superior Essex cable part number 09-092-02,6 pair buried drop.

E. MULTI-MODE FIBER OPTIC

All multi-mode fiber optic cable must 50.0/125 micron. All multi-mode terminations are to be LC, UPC finish. A 12- or 24-fiber adapter panel must be used in the fiber optic enclosure.

F. SINGLE-MODE FIBER OPTIC

All single-mode fiber optic cable must be 9.0/125. All single-mode terminations are to be LC, UPC finish. A 12- or 24-fiber adapter panel must be used in the fiber optic enclosure.

G. AIR-BLOWN FIBER COMPONENTS

Tube cell count for tube-cell cabling will be determined by Network Engineering and Development Staff on a project by project basis.

All new building IDFs and MDFs will require the installation of fiber distribution boxes. Other locations such as manholes and other splice or junction locations will require fiber distribution boxes as needed.

2.3. DATA TERMINATIONS

A. COPPER DATA COMPONENTS

1. Patch Panels

All data patch panels for existing buildings are to be modular, Category 6, in either 1U, 24 port or 2U, 48 port configuration, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E requirements. All data patch panels for new buildings are to be modular, Category 6A, in either 1U, 24 port or 2U, 48 port configuration, and must meet or exceed EIA/TIA and ISO/IEC Category 6A/Class E arequirements.

Every group of 48 must be separated by 2U of horizontal cable management, Panduit part# WMPF1E. All cabling will route through the rear cable management prior to termination in the patch panel. All terminations are to follow ANSI/EIA/TIA 568-B.

2. Voice Copper Termination Blocks

All voice wire terminations are to be terminated on patch panel(s) in data rack(s). One pair per RJ-45 block, terminated on blue/white-blue.

3. Data Jacks

All data jacks for existing buildings shall be modular, unshielded, 4-pair, 8P8C, Category 6, black unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E requirements.

All data jacks for new buildings shall be modular, unshielded, 4-pair, 8P8C, Category 6A, black unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6A/Class Ea requirements.

All terminations are to follow ANSI/EIA/TIA 568-B.

4. Faceplates

All faceplates shall be 4 port, light almond (or vendor equivalent), single gang, low profile, with a window for labels. All unused ports must be covered with a blank insert.

B. FIBER OPTIC

a. Terminations

Terminations will be completed with one of the two following methods:

- No epoxy/no polish connectors
- Factory-terminated pigtails with fusion splicing

Fusion splices will be protected in splice cases or other suitable enclosures.

b. Connectors

Multi-mode and single-mode fiber is to be terminated with LC style connectors, UPC Polish.

c. Fiber enclosures

TE Connectivity fiber optic enclosures models RMG-2000-000B or RMG-4000-000B will be used. RMG-4000-000B will be used when installing more than 24 fiber strands or at the request of network engineering. RMG-2000-000B will be used when installing 24 fiber strands or less. Equivalent enclosures can be approved by Network Development and Engineering on a case-by-case basis.

d. Fiber Adapter Panels

Multi-mode and single-mode fiber will terminate in 12- or 24-fiber standard adapter panels. Adapter panels must fit in TE Connectivity fiber enclosures.

2.4. DATA EQUIPMENT RACKS

All racks are to be four post, open frame, square hole, black, Panduit part number R4PCN. Substitutions must be authorized in writing by UNLV Network Development and Engineering.

2.5. CABLE TRAYS

All cable trays for distribution of data cables within a building are to be a minimum of 18" wide by 4" deep, solid trough or ladder and will be approved by UNLV Planning and Construction and Network Development and Engineering

2.6. EXCEPTIONS

Due to unique constraints and requirements of existing IDFs, exceptions may be authorized for existing buildings only with approval of UNLV Network Development and Engineering and shall be granted in writing.

3. PART III – EXECUTION

The University has drawings detailing existing cable runs, terminal cabinets/closets, risers, etc. Copies may be obtained from UNLV Network Development and Engineering to facilitate the requirements of Part III - Execution.

Unless otherwise expressly provided in the Contract, any provisions of the standard specifications, which require the University to inspect certain material or work, shall mean that the University has the option, rather than the obligation, to do so. Any warranty or guarantee provisions contained in the Contractors'/Vendors' standard specifications shall be of no effect and the warranty and guarantee provisions, if any, of the Contract shall apply.

3.0. DEMOLITION

A. COORDINATION WITH UNIVERSITY OPERATIONS

No telecommunication or data jacks, cabling terminals, or other hardware will be moved, disconnected, or removed without prior approval of UNLV Network Development and Engineering. Coordination of demolition activities with the departments will be strictly enforced to minimize service disruptions.

B. WORK TO BE PERFORMED BY OWNER

Upon notification by contractor, UNLV Network Development and Engineering will dispatch a technician to the requested work location. The technician will determine if the facilities to be moved or removed are in service (hot) or out of service (dead). If station cabling is dead the technician will insure that all cross-connects have been removed. If the facilities to be moved or removed are determined to be in service, the technician will take the necessary actions to render the facilities dead. Under NO circumstances will removal of telecommunications or data facilities begin until UNLV Network Development and Engineering has ensured that services are dead.

C. DISPOSAL OF SURFACE-MOUNT RACEWAY

Surface mount raceway that has been vacated, or otherwise determined not required, will be removed after all cabling has been properly removed.

3.1. EXCAVATION

The Contractor shall be required to excavate for underground mechanical piping, and shall perform all auxiliary work that may be required to do so.

No trenching will commence until UNLV Planning and Construction and UNLV Network Development and Engineering grants approval. The University has drawings of existing underground utilities to assist the Contractor to locate all underground utilities. All Contractors are to <u>Call Before U Dig</u>. All lines damaged by Contractor will be repaired at Contractor's expense.

Asphalt and concrete pavement shall be sawed or cut to a depth necessary to bring about a straight-line break parallel to the sides of the trench, so as not to disturb the adjoining pavement.

All underground construction work, during progress and after completion, shall conform truly to lines and grades.

If the trench is excavated to a greater depth than that given, the Contractor shall, at his own expense, bring such excavation to required grade with such material as directed, notwithstanding that it may be necessary to bring such material from other localities or to purchase suitable materials.

The material excavated shall be deposited along the side of the trench in such a manner as to create the least inconvenience possible.

Contractor shall not obstruct the gutter of any street or driveways, but shall use all proper means to provide the free passage of surface water along the gutters into storm water inlets. Contractor shall provide channels where required.

Special care shall be taken to keep all fire hydrants and gate valves on water mains accessible at all times. Fire lanes are to be kept open.

Wherever required, sides of the trench shall be sheeted and braced in strict accordance to the rules, orders and regulations of the State, County, and the City. Trenches shall be barricaded.

Grass will be replaced by a method approved by the University.

Bricks, blocks and other debris removed from trenches will not be used as fill for trenches.

3.2. INSTALLATION

A. REGULATIONS

All work and materials will comply with all federal and State laws, municipal ordinances, codes, regulations and direction of inspectors appointed by proper authorities having jurisdiction.

If there are violations of codes, the vendor will correct the deficiency at no cost to the University.

Working conditions must meet the industry standards for safety and work procedures, and protection of property established by prevailing rules, regulations, codes, and ordinances.

B. QUALITY ASSURANCE

Workmanship and neat appearance shall be as important as the mechanical and electrical efficiency of the system. All testing and clean-up shall be completed to the satisfaction of UNLV Network Development and

Engineering before sign-off. This includes, but is not limited to, cable testing, proper labeling, debris removal, and proper cable bundling and routing.

C. DAMAGE OF EXISTING FACILITIES

The Contractors shall be responsible for replacing, restoring, or bringing to at least original condition any damage to floors, ceilings, walls, furniture, grounds, pavement, etc., caused by its personnel and operations. Any damage or disfiguration will be restored at the Contractor's expense.

D. COORDINATION

Contractor is responsible for insuring minimal disruption of existing television, telemetry, telephone and data communications facilities and networks.

Outages shall be scheduled only with permission from UNLV Network Development and Engineering at its convenience.

All work areas shall be cleared of all litter, and properly disposed of by Contractor on a daily basis.

At its own expense, Contractor shall erect temporary fencing where required or deemed necessary by University personnel, or where deemed necessary by the Contractor for securing materials.

Contractors shall provide all necessary temporary equipment and material, shall maintain them in a safe and adequate manner, and shall remove them immediately upon completion of work requiring their presence.

E. CABLE SUPPORT AND ANCHORS

All cables, wires and equipment will be firmly anchored. Fasteners and supports shall be adequate to support loads with ample safety factors.

All data cables installed without conduit in plenum spaces will be secured using j-hooks or other Network Development and Engineering approved mounting hardware.

F. FIRESTOP SYSTEMS

A firestop system is comprised of an item or items penetrating a fire rated structure, the opening in the structure, the sealing materials, and assembly of the materials used to seal the penetrated structure. Firestop systems comprise an effective block for fire, heat, vapor and pressurized water stream. All penetrations through fire rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating items i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire stopped using state approved fire resistant materials installed in accordance with the manufacturer's tested methods. All penetrations through fire rated surfaces shall comply with the following:

- 1. ASTM E 84: Standard Test Methods for Surface Burning Characteristics of Building Materials
- 2. ASTM E 119: Methods of Fire Tests of Building Construction Materials
- 3. ASTM E 814: Standard Method of Fire Tests of Through-Penetration Firestops
- 4. ASTM C 719: Adhesion and Cohesion of Elastomeric Joint Sealants under Cyclic Movement
- 5. ASTM C 920: Standard Specification of Elastomeric Joint Sealants
- 6. UL 263: Fire Tests of Building Construction Materials
- 7. UL 723: Surface Burning Characteristics of Building Materials
- 8. UL 1479: Fire Tests of Through Penetration Firestops
- 9. UL 2079: Standard for Fire Tests of Joint Systems

G. CONDUIT

Conduit shall be Electrical Metallic Tubing produced in accordance with ANSI C80.3 standard and run in the most direct route practical.

Conduit runs containing more than two 90-degree bends, or a reverse (180 degree) bend require a pull box.

All offsets shall be considered equivalent to a 90-degree bend.

Sections of conduit longer than 100 ft require a pull box.

Conduit bend radii will be a standard ten times the outside diameter of conduit unless otherwise approved by UNLV Network Development and Engineering.

Conduits entering the IDF through the wall shall be reamed or bushed, and terminated not more than 4 inches from the wall surface.

Conduits entering the IDF from below shall be terminated 4 inches above finished floor.

Conduit runs for distribution cables (both horizontal and vertical), except station outlets, shall be not less than 4" in diameter. They will be equipped with a plastic or nylon number 12 or larger pull line that is rated at 800-lb. test minimum.

Conduit installed for data and/or voice cabling may not be shared with any other cable.

All conduit runs for station outlets shall be not less than 3/4" in diameter. All conduit runs for station outlets with more than 3 cables shall be not less than 1" in diameter. They will be equipped with a plastic or nylon number 12 or larger pull line that is rated at 800-lb. test minimum.

After installation, all conduits shall be clean, dry, unobstructed, capped for protection and labeled with their destination (by room number) for identification.

Allowable fill capacity is 40% or as defined by the National Electric Code, whichever is lower.

Conduit runs for horizontal distribution cables, utilizing the trapeze hanger method to support the conduits, shall utilize threaded rods of not less than 3/8" in diameter.

Conduit shall not block access to existing services.

Pull boxes will be installed in position and relationship to adjoining work, securely anchored to supporting structure, sealed and finished, and in a manner which produces a level box with square, plumb, and straight edges.

H. CABLE INSTALLATION

All cable shall be installed free of kinks. A kink is defined as a violation of the manufacturer's specified Minimum Bend Radius for each type of cable. Cable shall not be formed into a condition that causes the outside sheath to wrinkle.

Any cable to be placed through an electrical room or any other potentially hazardous conditional shall be placed in conduit.

All cable will be secured to the backboard in such a manner as to allow cross connections to be made without crossing over any cables.

All data outlets will have a minimum of eight (8) inches of cable stored at each drop after the cable has been terminated.

Where installation of conduit is not required, plenum cable will be used. Cables are not permitted to lie atop a lay-in ceiling or simply drape over pipe and ductwork; appropriate J-hook/supports or dressing will be used.

Cable supports are to be anchored in accordance with TIA 569-C and NEC.

Cable pulled in a cable tray with existing cable should not be pulled where stress would be applied to the existing cable.

All cable is to be terminated at both ends, tested, labeled and ready to provide service to and within the building.

Hook and loop tape is the only approved product for bundling cable. Tiewraps will not be used bundle cable.

Installation to meet or exceed ANSI/EIA/TIA 568-C and ANSI/EIA/TIA 569C. UNLV Network Development and Engineering must approve completed installation.

I. CABLE TESTING

All cables and termination hardware shall be 100% tested for defects in installation and to verify cable performance under installed conditions. The contractor, prior to system acceptance, shall verify all conductors of each installed cable. Any defect in the cabling system installation including but not limited to cable, connectors, feed-through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% usable conductors in all cables installed.

1. Copper Data Cable

All Data cables shall be tested in accordance with ANSI/TIA-568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard or better and best industry practices. If any of these are in conflict, the Contractor shall be responsible to bring any discrepancies to the attention of UNLV Network Development and Engineering.

a. Testing

Each cable shall be tested for wire map, length and performance. The data cables shall be bi-directional tested using a ANSI/TIA 1152 level III or better cable analyzer. The cable analyzer shall be within the calibration period recommended by the manufacturer.

Wire Map

Each pair of each installed cable shall be tested for continuity, opens, shorts, pair-reversals, split pairs, transposed pairs, and any other misswiring. The test shall be recorded as pass/fail as indicated by the test set in accordance with the manufacturers recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.

□ Length

Each installed cable shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the TIA/EIA-568-C.2 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the longest pair length shall be recorded as the length for the cable.

Performance Verification

Category 6 or 6A data cable shall be performance verified using an automated test set. This test set shall be capable of testing for the continuity and length parameters defined above, and provide results for the following tests:

- 1. Propagation Delay
- 2. Delay Skew
- 3. Insertion Loss
- 4. NEXT (Near-End Crosstalk)
- 5. PS NEXT (Power Sum Near-End Crosstalk)
- 6. ACR-N (Attenuation to Crosstalk Ratio Near-End) recorded for information only

- 7. PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End) – recorded for information only
- 8. ACR-F (Attenuation to Crosstalk Ratio Far-End)
- 9. PS ACR-F (Power Sum Attenuation to Crosstalk Ratio FarEnd)
- 10. Return Loss
- 11. TCL (Transverse Conversion Loss) recorded for information only
- 12. ELTCTL (Equal Level Transverse Conversion Transfer Loss) recorded for information only
- Equipment

Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA/EIA 568-C.2 Standard, and the result shown as pass/fail. Test results shall be printed directly from the test unit or from a download file using an application from the test equipment manufacturer. The printed test results shall include all tests performed, the expected test result and the actual test result achieved. All test results to be provided to UNLV Network Development and Engineering in .PDF and

Linkware format prior to acceptance of completed project. All test results must be labeled with the specific data cable that was tested by its identifier on the patch panel.

2. Fiber Optic

Test results shall be automatically evaluated by the equipment, using the most up-todate criteria from the TIA/EIA 568-C3 Standard, and the result shown as pass/fail. The test results shall include all tests performed, the expected test result and the actual test result achieved. All test results to be provided to the UNLV Network Development and Engineering in .PDF format prior to acceptance of completed project. All test results must be labeled with the specific data cable that was tested by its identifier on the patch panel.

Test evaluation for the panel to panel (backbone) shall be based on the values set forth in the EIA/TIA-568-C.3, Optical Fiber Cabling Components.

Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.

The expected results for each cable (or group of cables of the same nominal length) shall be calculated before the start of testing and recorded in a space provided on the Contractor's test matrix. Each strand of fiber in the respective cable shall be evaluated against this target number. Any fibers that exceed this number by more than -0.5dB shall be repaired or replaced at the installers' cost.

Where concatenated links are installed to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. After the link performance test has been successfully completed, each link shall be concatenated and tested. The test method shall be the same used for the test described above. The evaluation criteria shall be established between UNLV Network Development and Engineering and the Contractor prior to the start of the test.

a. Multi-mode

All multi-mode optical fiber attenuation shall be measured at 850 nanometers (nm) and 1300 nm using an LED light source and power meter. Test set-up and performance shall be conducted in accordance with ANSI/TIA-568-C.3. One 2-meter patch cord shall be used for the test reference and two 2-meter patch cords shall be used for the actual test. This test method uses a one-jumper reference, two-jumper test to estimate the actual link loss of the installed cables plus the loss of two connectors. This measurement is consistent with the loss that network equipment will see under normal installation and use. Test evaluation for the panel to panel (backbone) or panel to outlet (horizontal) shall be based on the values set forth in the EIA/TIA-568-C.3, Optical Fiber Link. Multi-mode fiber optic cable must meet or exceed the following limits:

Attenuation

3.5dB/km at 850nm, 1.5dB/km at 1300nm.

- Bandwidth
 1500MHz*km at 850nm, 500MHz*km at 1300nm.
- Connectors
 Max loss for a mated pair of connectors shall be less than 0.5dB
- b. Single-mode

Single mode optical fiber attenuation shall be measured at 1310 nm and 1550 nm using a laser light source and power meter. Tests shall be performed at both wavelengths in one direction on each strand of fiber. The set-up and test shall be performed in accordance with EIA/TIA-526-7 Standard, Method 1A. Two-meter patch cords shall be used as test references and for the actual test. This test method utilizes a one-jumper reference, two-jumper test to estimate the actual link loss of the install cable plus two patch cords. Single-mode fiber optic cable must meet or exceed the following limits:

- Attenuation
 0.4dB/km at 1310nm, 0.3dB/km at 1550nm.
 - Connectors Max loss for a mated pair of connectors shall be less than 0.5dB

3. OTDR

Each cable shall be tested with an Optical Time Domain Reflectometer (OTDR) to verify installed cable length and splice losses. The OTDR measurements for length shall be performed in accordance with ANSI/TIA 568-C.2. The measurements to determine splice loss shall be performed in accordance with manufacturer's recommendations and best industry practices.

4. As-Builts

All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. The As-built drawings shall clearly identify the patch panel label and it's corresponding station side location. As-builts will be created from latest digital architectural drawings, to most closely resemble exact building conditions, as possible. Hand drawings are not acceptable. As-builts & test results must be provided in both .PDF and CAD format. Upon acceptance of contract, vendor will be required to provide an acceptable time-line for provision of As-Built drawings. Acceptable time-line shall be verified by UNLV Network Development and Engineering. Ample time must be allocated for verification of As-builts & test results

and subsequent corrected versions of those documents. Network equipment (Including Voice, Data and A/V services) will not be provisioned until this documentation is provided.

4. APPENDIX A – EXHIBITS



UNLV CAMPUS WIRING SPECIFICATION

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4.1. STANDARD LABELING SCHEME



Patch Panel Labels :

Patch panels will be labeled as shown. The label will be a number unique to the rack. If it is the top patch panel in the rack it will be labeled 1. If it is the next patch panel down from the top it will be labeled 2 and so on. Each patch panel port will be labeled as shown using the scheme listed above



4.2. AS- BUILT EXAMPLE

UNLV School of Medicine Interim Space Tenant Improvement November 30, 2015



4.3. CONTRACTOR SUMMARY

This summary is intended to provide an overview of key requirements that contractors of small data cabling installations will most often need to reference. Contractors will still be responsible for maintaining compliance with the entire wiring specification.

- A. Contractor requirements
 - 1. Certified to install for one of the approved manufacturers.
 - 2. RCDD on staff
 - 3. Supervisor and/or lead installer shall be BCSI certified installers and members in good standing
- B. Approved manufactures

1.

- Copper
 - a. TE connectivity
 - b. Leviton
 - c. Siemon
 - d. Panduit
- 2. Fiber
 - a. Air-blown fiber
 - Future Flex Air-Blown Network Solutions by Sumitomo Electric Lightwave
 - eABF solutions by AFL
 - b. Non-air-blown fiber
 - Corning
 - TE Connectivity
 - Siemon
 - Leviton
 - Panduit
- C. Warranty
 - 1. All copper and fiber cabling installations must be covered by an end-toend manufacturer warranty of no less than 20 years. The warranty is required to cover cabling, components, and performance. Parts and labor for replacements must also be included in the warranty.

D. Cabling

- 1. Copper Data Cabling and Components
 - a. New buildings will be installed with Category 6A cable and components from one of the approved manufacturers.
 - b. Existing building will be installed with Category 6 cable and components from one of the approved manufacturers.
 - c. All data patch panels for existing buildings are to be modular, Category 6 or 6A, in either 1U, 24 port or 2U, 48 port configuration, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E or Category 6A/Class Ea requirements.
 - d. All data jacks shall be modular, unshielded, 4-pair, 8P8C, Category 6 or 6A, black unless otherwise specified, and must meet or exceed EIA/TIA and ISO/IEC Category 6/Class E or Category 6A/Class Ea requirements.
 - e. Terminations will follow wiring scheme TIA568-B.
 - f. Where installation of conduit is not required, plenum cable will be used. Cables are not permitted to lie atop a lay-in ceiling or simply drape over pipe and ductwork; appropriate J-hook/supports or dressing will be used.
 - g. Hook and loop tape is the only approved product for bundling cable. Tie-wraps will not be used bundle cable.

- h. Wire managers will be Panduit WMPF1E and WMPVHC45E
- i. Racks will be Panduit R4PCN
- j. Installations must comply with TIA 569-C and TIA568-C.2
- 2. Fiber Cabling and Components
 - a. Air-blown fiber tube cell conduit will be installed in all new buildings and in new building-to-building fiber installations.
 - b. Air-blown fiber will be used in existing buildings that contain existing air-blown fiber components.
 - c. Non-air-blown fiber will be used in existing buildings that do not have existing air-blown fiber components.
 - d. Terminations will be completed using no epoxy/no polish connectors or factoryterminated pigtails with fusion splicing
 - e. All fiber will be terminated with LC / UPC connectors and be mounted in 12- or 24- fiber adapter plates.
 - f. Fiber enclosures will be TE Connectivity models RMG-2000-000B, RMG-4000-000B, or NDE approved equivalent. Adapter plates will of standard size and will fit these enclosures.
- E. Documentation
 - 1. Labeling
 - a. Contractor will be responsible for labeling all installed cables.
 - The labeling scheme will use the format described in Section 4.1
 - Contractor will label the patch panel port, cable termination points, and faceplates.
 - Contractor will also be responsible for labeling any new patch panel
 - 2. Testing
 - a. All installed cables will be certified by an approved cable analyzer.
 - Test results will meet TIA-568-C.2 and TIA-568-C.3 requirements. Test results will be provided to Planning and Construction in PDF format upon completion. Network Engineering and Development will verify all test results prior to activating ports.
 - 3. As-builts
 - a. All installed cables will be documented on an as-built diagram. The diagram will indicate the location and actual label of all installed cabling. As-builts will be provided to Planning and Construction in PDF format upon completion. Network Engineering and Development will verify all that the data contained the as-builts matches the actual labels prior to activating ports.