

**SPECIFICATIONS AND CONTRACT DOCUMENTS
FOR**

**CITY OF ONTARIO POLICE DEPARTMENT
Media Room Tenant Improvement
Project No.: D&C23-017 OPD Media Room**

**2500 S. Archibald Avenue
Ontario, CA 91761**



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(JULY/2025)

SECTION 00 01 10

TABLE OF CONTENTS

DIVISION 0 – CONTRACT REQUIREMENTS

- 00 01 01 - Project Title Page
- 00 01 10 - Table of Contents

DIVISION 1 – GENERAL REQUIREMENTS

- 01 03 00 - Post-Bid Interview
- 01 21 00 - Allowances
- 01 25 00 - Substitution Procedures
- 01 25 01 - Substitutions Request Form
- 01 33 00 - Submittal Procedures
- 01 60 00 - Product Requirements
- 01 66 00 - Product Storage and Handling Requirements
- 01 73 29 - Cutting and Patching
- 01 77 00 - Project Closeout
- 01 78 36 - Warranties

DIVISION 2 – EXISTING CONDITIONS

- 02 41 19 - Selective Demolition

DIVISION 3 – CONCRETE

- 03 10 00 - Concrete Forming and Accessories
- 03 20 00 - Concrete Reinforcing
- 03 30 00 - Cast-In-Place Concrete

DIVISION 4 – MASONRY

NOT USED

DIVISION 5 – METALS

- 05 12 00 - Structural Steel Framing
- 05 40 00 - Cold-Formed Metal Framing
- 05 50 00 - Metal Fabrications
- 05 51 36.16 - Metal Ramps

DIVISION 6 – WOOD, PLASTICS, AND COMPOSITES

- 06 10 00 - Rough Carpentry
- 06 41 00 - Architectural Casework

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

- 07 05 00 - Concrete Floor Testing
- 07 21 00 - Thermal Insulation

- 07 25 00 - Sheet Weather Barrier
- 07 26 16 - Below-Grade Vapor Barrier
- 07 60 00 - Flashing and Sheet Metal
- 07 84 00 - Firestopping
- 07 90 00 - Joint Protection
- 07 95 00 - Expansion Control

DIVISION 8 – DOORS AND WINDOWS

- 08 11 00 - Metal Doors and Frames
- 08 11 25 - Interior Aluminum Doors and Frames
- 08 14 00 - Wood Doors
- 08 31 13 - Access Doors and Frames
- 08 41 13 - Aluminum-Framed Entrances and Storefronts
- 08 71 00 - Door Hardware
- 08 80 00 - Glazing

DIVISION 9 – FINISHES

- 09 05 61.13 - Moisture Vapor Emission Control
- 09 21 13 - Plaster Assemblies
- 09 29 00 - Gypsum Board
- 09 51 00 - Acoustical Ceilings
- 09 51 53 - Direct-Attached Acoustical Ceilings
- 09 65 00 - Resilient Flooring and Base
- 09 68 00 - Carpeting
- 09 78 19 - Wall Coverings
- 09 84 00 - Acoustical Wall Panels
- 09 84 13 - Sound Absorbing Wall Units
- 09 90 00 - Painting

DIVISION 10 – SPECIALTIES

- 10 14 00 - Signage
- 10 22 13 - Security Mesh
- 10 44 00 - Fire Protection Specialties

DIVISION 11 – EQUIPMENT

- 11 31 13 - Appliances

DIVISION 12 – FURNISHINGS

- 12 20 00 - Window Treatment - PENDING

DIVISION 13 – SPECIAL CONSTRUCTION

NOT USED

DIVISION 14 – CONVEYING EQUIPMENT

NOT USED

DIVISION 21 – FIRE SUPPRESSION

NOT USED

DIVISION 22 – PLUMBING

NOT USED

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

- 23 00 10 - Basic Mechanical Requirements
- 23 05 23 - General-Duty Valves for HVAC Piping
- 23 05 29 - Hangers and Supports
- 23 05 53 - Identification for HVAC Piping and Equipment
- 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- 23 07 13 - Duct Insulation
- 23 07 19 - HVAC Piping Insulation
- 23 21 13 - Hydronic Piping
- 23 31 00 - HVAC Ducts and Casings
- 23 33 00 - Air Duct Accessories
- 23 37 00 - Air Outlets and Inlets

DIVISION 26 – ELECTRICAL

- 26 00 10 - Basic Electrical Requirements
- 26 05 19 - Low-Voltage Electrical Power Conductors and Cables
- 26 05 26 - Grounding and Bonding for Electrical Systems
- 26 05 29 - Hangers and Supports for Electrical Systems
- 26 05 33.13 - Conduit for Electrical Systems
- 26 05 33.16 - Boxes for Electrical Systems
- 26 05 53 - Identification for Electrical Systems
- 26 05 83 - Wiring Connections
- 26 08 02 - Installation & Acceptance Testing of Electrical Systems
- 26 09 23 - Lighting Control Devices
- 26 27 26 - Wiring Devices
- 26 51 00 - Interior Lighting
- 26 51 20 - Automatic Lighting Control System

DIVISION 27 – COMMUNICATIONS

- 27 00 00 - Common Work Results for Communications
- 27 05 28 - Pathways for Communications Systems
- 27 05 36 - Cable Tray
- 27 05 53 - Identification for Communications Systems
- 27 11 16 - Communications Room Equipment
- 27 13 23 - Backbone Cabling
- 27 15 13 - Horizontal Cabling
- 27 16 19 - Patch Cords
- 27 17 00 - Testing of Structured Cabling Systems
- 27 41 16 - Audiovisual Systems

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

- 28 00 00 - Common Work Results for Security
- 28 10 00 - Access Control and Alarm Management System

DIVISION 31 – EARTHWORK

- 31 10 00 - Site Clearing
- 31 22 00 - Grading
- 31 23 16 - Excavation Fill Paving
- 31 23 23 - Excavation Fill Utilities
- 31 23 26 - Base Course

DIVISION 32 – EXTERIOR IMPROVEMENTS

- 32 01 17 - Asphalt Pavement Repair
- 32 12 16 - Asphalt Paving
- 32 12 36 - Seal for Bituminous Surfacing
- 32 13 13 - Site Concrete Work
- 32 17 26 - Detectable Warning Surfacing

DIVISION 33 – UTILITIES

- 33 40 00 - Storm Drainage Utilities

END OF SECTION

SECTION 01 03 00

POST BID INTERVIEW

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 DESCRIPTION

This Section requires the apparent low bidder to attend and participate in a POST BID INTERVIEW with the OWNER and ARCHITECT, prior to award of any contract by the OWNER. The POST BID INTERVIEW will be conducted by the ARCHITECT within fifteen (15) calendar days after the date of bid. The Interview will take place at the Architect's Office.

1.03 PURPOSE

- A. Contractor acknowledgment of a complete and accurate bid.
- B. Contractor submission of a fair and equitable bid.
- C. Fair comparisons of bid.

1.04 REQUIRED ATTENDANCE

- A. A duly authorized representative of the apparent low bidder is required to attend the POST BID INTERVIEW, in person.
- B. The apparent low bidder's authorized representative must have signatory authority on behalf of the apparent low bidder.
- C. Failure to attend the POST BID INTERVIEW will be considered just cause for the Owner to reject the Bid.

1.05 POST BID INTERVIEW PROCEDURE

- A. The ARCHITECT will review the Bidder's Proposal with the attendees.
- B. The ARCHITECT will review the Contract Documents with the attendees, including but not limited to:
 - 1. Insurance
 - 2. Bonding
 - 3. Addenda
 - 4. Pre-Bid Clarifications
 - 5. Bid / Voluntary Alternates
 - 6. Schedule of Values for all Sub-Contractor Work listed according to the Table of Contents for the Project Manual.
 - 7. Value Engineering
 - 8. The Contract Plans
 - 9. The Contract Specification
 - 10. Critical Materials
 - 11. General Contract Schedule Requirements

Contractor's Initial _____

- 12. Prevailing Wage Requirements
- 13. Liquidated Damages
- 14. Required Docs for Contract Administration
- 15. Contract Coordination Requirements

1.06 POST BID INTERVIEW DOCUMENTATION

The ARCHITECT will document the POST BID INTERVIEW on the form attached to this Section. Both the Apparent Low Bidder and the OWNER are required to sign the POST BID INTERVIEW Documentation. The POST BID INTERVIEW Documentation is a Contract Document, and all items recorded in the POST BID INTERVIEW Documentation are part of the Contract and shall be enforced accordingly.

PART 2 – INFORMATION

2.01 BIDDER INFORMATION

- A. Name: _____
- B. Phone: _____
- C. Fax: _____
- D. Date: _____
- E. Time: _____

2.02 INTRODUCTIONS / SIGN-IN

- A. Contractor:
 - 1. _____
 - 2. _____
 - 3. _____
- B. Owner:
 - 1. _____
 - 2. _____
 - 3. _____
- C. Architect:
 - 1. _____
 - 2. _____
 - 3. _____

Contractor's Initial _____

PART 3 – INTERVIEW

3.01 PURPOSE OF INTERVIEW IS TO ASSURE

- A. Contractor acknowledgment of a complete and accurate bid.
- B. Contractor submission of a fair and equitable bid.
- C. Fair comparisons of bid.

3.02 CONTRACTUAL REQUIREMENTS

A. Can you meet all specified bonding requirements?	Yes	No
B. Can you meet all specified insurance requirements?	Yes	No
C. Acknowledge that you are required to comply with the prevailing wage Requirements?	Yes	No
D. Are you prepared to bind every subcontractor, supplier, and vendor, to the terms of the contract as far such terms are applicable to each subcontractor's work?	Yes	No
E. Acknowledge inclusion in the bid of all Addenda?	N/A	Yes No
F. Acknowledged Receipt of Pre-Bid Clarifications (RFI) Submitted?	N/A	Yes No
G. Acknowledge inclusion in the Bid of all Allowances? 1. 2. 3. 4.	N/A	Yes No
H. Acknowledge inclusion in the Bid of all Alternates? 1. 2. 3. 4.	N/A	Yes No
I. Acknowledge that you are required to comply with the SWPPP.	Yes	No
J. Acknowledge that you are required to comply with the PM-10	Yes	No

Contractor's Initial _____

3.03 SCOPE OF WORK

A. Are the plans and specifications clear and understandable?	Yes	No
B. Are there any items that need to be identified or require clarification? If yes, please identify item. 1. 2. 3. 4. 5. 6.	Yes	No
C. Is (are) the cost(s) for the above items (as applicable) included in your proposal items?	Yes	No
D. Review bid alternatives (if applicable) 1. 2. 3.	N/A	Yes No
E. Are you proposing any substitutions? If yes, please identify item. 1. 2. 3. 4. 5. 6. 7. 8. 9.	N/A	Yes No

Contractor's Initial _____

3.04 Are you proposing any VALUE ENGINEERING? (describe)

1. Add / Deduct
2. Add / Deduct
3. Add / Deduct
4. Add / Deduct
5. Add / Deduct
6. Add / Deduct
7. Add / Deduct
8. Add / Deduct
9. Add / Deduct
10. Add / Deduct
11. Add / Deduct
12. Add / Deduct
13. Add / Deduct

VALUE ENGINEERING TOTAL \$ _____

BASE BID \$ _____

PROPOSED REVISED TOTAL \$ _____

Contractor's Initial _____

3.05 SCHEDULE

- A. Can you meet the construction duration stipulated in the Contract? Yes No
- B. Can you meet Submittal Schedule Deadlines? Yes No
- C. Will you provide Cost and Manpower loading for your construction schedule activities to within the required seven (7) calendar days, per the Contract?
(Section 01 31 00 – Construction Schedule) Yes No
- D. It is understood the Project schedule is critical. Can you accelerate any and all schedule activities if the requirement occurs? Yes No

- E. If not, what must change and why?

- F. Identify critical materials, deliveries and dependencies (long lead), including Owner Furnished items that could affect the completion of your work.

1.

2.

3.

4.

5.

6.

7.

- G. You have reviewed the “Time for Completion” set forth in the Agreement, and you further understand the Owner MAY assess liquidated damages if you fail to complete this Project within same. You further understand any delays caused by you or your subcontractors WILL require your company to accelerate the Work upon written direction by the Owner, in order to complete this Project on time, as stipulated in the Agreement.

Yes No

- H. You agree that failure to meet the completion date is just cause for the OWNER to assess and retain Liquidated Damages in accordance with the Contract Documents.

Yes No

Contractor's Initial _____

3.05 CONTRACTOR COMMENTS / SUGGESTIONS

- A. _____
- B. _____
- C. _____
- D. _____
- E. _____
- F. _____
- G. _____
- H. _____

3.06 AGREEMENT

- A. Contractor agrees that the information contained herein is part of your contractual obligations. Your signature acknowledges your agreement to perform all work discussed herein, and that costs for all work are included in your proposal. The foregoing information is true and accurate, and I am authorized to sign as an officer of the company I am representing.

Company Name: _____

Signature: _____

Name: _____

Title: _____

Date: _____

3.07 WITNESS

- A. Owner

Company Name: _____

Signature: _____

Name: _____

Title: _____

Date: _____

- B. Architect

Company Name: _____

Signature: _____

Name: _____

Title: _____

Date: _____

Contractor's Initial _____

SECTION 01 21 00

ALLOWANCES

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Allowances which the General Contractor shall provide for designated construction activities in the Work and in this bid.

1.02 RELATED DOCUMENTS

- A. The Conditions of the Contract and other section of Division 01 apply to this section as fully as if repeated herein.

1.03 DESCRIPTION OF REQUIREMENTS

- A. Definitions and Explanations: Certain requirements of the construction related to each allowance are indicated and specified. The allowance has been established by the Owner and represents selection by the Owner for designated portions of the Work specified and shown.
- B. Types of allowance scheduled herein for the Work include lump sum cash allowances. Include all allowances in Contract sum, and identify all allowances in Schedule of Values as separate line items.
- C. Selection and Purchase: At earliest feasible date after award of contract, advise the Construction Manager of scheduled date when final selection and purchase of each product or system described by each allowance must be accomplished in order to avoid delays in performance of the Work.
 - 1. Establish date by which the General Contractor must enter into contract and coordinate with sub-contractor responsible for work defined by allowance.
 - 2. Establish date by which final list of products must be established for purchase of products and systems as specifically selected by the Owner.

1.04 DEFINITIONS AND DESCRIPTION OF REQUIREMENTS

A. Cash Allowance Criteria

- 1. The Allowance is used only as directed by the Owner.
- 2. The Allowance is used exclusively for the Owner's purposes and for the defined Scope of Work.
- 3. The General Contractor will prepare detailed breakdown of all costs associated with the work defined for the allowance. These amounts will be charged against the Allowance by Change Order, based on final detailed payment receipts and back-up as required by Architect and Construction Manager, and will include all direct costs of work performed under the defined work scope.
 - a. The General Contractor shall obtain quotes for equipment from three separate vendors and present to Owner for consideration and selection.
- 4. The General Contractor shall include in the base bid contract amount all cost of coordination, supervision, bond costs, overhead and profit, supervision, installation and all indirect project costs associated with the work defined. Where allowance amount is not exceeded, no general contractor costs will be permitted to be charged against the allowance amounts specified below.
 - a. At project closeout, unused Cash Allowance amounts shall be credited to the Owner by Change Order.

- b. Changes that exceed the amount of each allowance will be processed as a Change Order per Contract Documents.

B. Material and Labor Allowance Criteria

1. Applies to all material and labor allowances identified in the contract documents.
2. The Allowance is used only as directed by the Owner.
3. The Allowance is used exclusively for the Owner's purposes and for the defined Scope of Work.
4. The General Contractor will prepare detailed breakdown of all costs associated with the work defined for the allowance. These amounts will be charged against the Allowance by Change Order, based on final detailed payment receipts and back-up as required by Architect and Construction Manager, and will include all direct costs of work performed under the defined work scope.
 - a. The General Contractor shall obtain quotes for equipment from three separate vendors and present to Owner for consideration and selection.
5. The General Contractor shall include in the base bid contract amount all cost of coordination, supervision, bond costs, overhead and profit, supervision, installation and all indirect project costs associated with the work defined. Where allowance amount is not exceeded, no general contractor costs will be permitted to be charged against the allowance amounts specified below.
 - a. At project closeout, unused Material and Labor Allowances shall be credited to the Owner by Change Order based on the cash value established per Section 1.04.B.4.
 - b. Changes that exceed the amount of each allowance will be processed as a Change Order per Contract Documents.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

3.01 SCHEDULE OF CASH ALLOWANCES

Included in the Total Bid Amount are the Allowances identified below. Items covered by Allowances shall be provided for such amounts and by such persons or firms as the Owner may direct.

Building and Site Work

ALLOWANCE 01 – Landscape Improvements:	\$ 30,000
ALLOWANCE 02 – Demolition:	\$ 25,000
ALLOWANCE 03 – Fire Protection / Alarm Systems:	\$ 25,000
ALLOWANCE 04 – Miscellaneous:	\$ 25,000

Contractor shall itemize the allowances listed above on the bid form in the designated areas for any additional effort, over and above contract work due to existing conditions, obstructions or unforeseen items encountered which are not readily discernible prior to construction. Allowance will also be used at the Owner's discretion for any required supplemental work.

END OF SECTION

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 SUMMARY

- A. Section includes administrative and procedural requirements for product substitutions.
- B. These procedures do not apply to section(s) that are marked NO SUBSTITUTIONS.

1.03 STANDARDS AND REFERENCES

- A. Definition: A substitution is a proposed change by the Contractor in products, materials, equipment and/or methods of construction from those required by the Contract Documents.
- B. Requirements:
 - 1. Comply with the Industry Standards and References as set forth in the specific Sections.
 - 2. For products specified by stating “or other approved” or “or approved equal” or other such wording on drawings or within specifications sections, submit a request for substitutions for any product or manufacturer which is not specifically named.

1.04 QUALITY ASSURANCE

- A. The Bidder represents that in making a legitimate, authorized formal request for substitution:
 - 1. A thorough investigation has transpired concerning the proposed product, and it has been determined that it is equal to or superior in all respects to that specified.
 - 2. The same warranties or bonds and guarantees will be provided as for that specified.
 - 3. Installation of the accepted substitution will be coordinated into the work; and such changes to in-place work, ordered materials and products, or other work to be in progress prior to installation of the requested substitutions, will be performed without any additional cost to the OWNER.
- B. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.05 SUBMITTALS

- A. Provide in accordance with Section 01 33 00
- B. Deadlines:
 - 1. Pre-Bid: Submittals are due (14) Calendar Days prior to the Published Bid Deadline.
 - 2. After Award of Contract:
 - a. Substitution requests will be considered to provide competition or only if the specified product or system has gone out of production prior to bidding, or specified product or system has been deemed illegal or dangerous by governing agencies having jurisdiction over this project.
 - b. Provide within thirty (30) calendar days after the Notice of Award in accordance with Section 01 33 00; formal requests will be considered for substitutions of products in place of those specified.

- C. Substitution Requests: Submit three (3) hard copies and an electronic version 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 Section 01 25 01.
 2. Documentation: Show compliance with requirements for substitutions and the following is applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Included annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with current California Building Code.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
 3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 7 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

- a. Forms of Acceptance: Change Order.
- b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

PART 2 – PRODUCTS

2.01 SUBSTITUTIONS

A. Substitutions of Equipment and Materials During Bidding

1. Requests for Substitutions: The Bidder shall make Requests for Substitution on the Owner's Requests for Substitution form included in the Bidding Documents. Such requests shall comply with the requirements of the Bidding Documents, including without limitation, the Plans and the Specifications, without limitation to the other requirements of the Request for Substitution form, requests for Substitutions shall include:
 - a. A description of the material, equipment or other work that is to be replaced or eliminated by the Substitution;
 - b. A description of any other changes to the Work, Existing Improvements, the Site or the work of Separate Contractors that would be necessary if the proposed Substitution were incorporated as part of the Work;
 - c. A statement that the bidder accepts responsibility for the inclusion in its Bid of all of the costs of implementing the Substitution, including, without limitation, the costs of any related changes to the Work, Existing Improvements, the Site or the work of Separate Contractors;
 - d. All the drawings, performance and the test data and other information necessary for an evaluation of the Substitution by the Owner, Architect and Owner's Consultants; and
 - e. A statement that the Bidder understands and agrees that if the Substitution is not approved and the Bidder submits a Bid, Bidder will provide the Work as specified in the Bidding Documents without such Substitution.
2. The burden of proof of the merit of a proposed Substitution is entirely upon the Bidder requesting the Substitution.

- B. After award of Contract, Architect will consider formal requests from the Contractor for substitution of products in place of those specified only in case of product unavailability or other conditions beyond the control of Contractor.

Requests for Substitutions made after the award of Contract shall conform to the requirements for Substitutions of Equipment and Materials during Bidding.

- C. Should a substitution be approved under the foregoing provisions and subsequently prove to be defective or otherwise unsatisfactory for the intended use or function, Contractor shall, without cost to Owner and without obligation on the part of the Architect replace the substitute with the product, material, or equipment originally specified, if available, or another substitution conforming to the above requirements.

PART 3 – EXECUTION

NOT USED

END OF SECTION

SECTION 01 25 01

SUBSTITUTION REQUEST FORM

Project: _____ Substitution Request Number: _____

To: _____ From: _____

Date: _____
A/E Project Number: _____
Re: _____ Contract For: _____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
Manufacturer: _____ Address: _____ Phone: _____
Trade Name: _____ Model No.: _____
Installer: _____ Address: _____ Phone: _____
History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

☐ Point-by-point comparative data attached — REQUIRED BY A/E

Reason for not providing specified item: _____

Similar Installation:
Project: _____ Architect: _____
Address: _____ Owner: _____
_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

Savings to Owner for accepting substitution: _____ (\$ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

Attachments: ☐

A/E's REVIEW AND RECOMMENDATION

- ☐ Approve Substitution - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
- ☐ Approve Substitution as noted - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures.
- ☐ Reject Substitution - Use specified materials.
- ☐ Substitution Request received too late - Use specified materials.

Signed by: _____ Date: _____

OWNER'S REVIEW AND ACTION

- ☐ Substitution approved - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures. Prepare Change Order.
- ☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01 33 00 Submittal Procedures. Prepare Change Order.
- ☐ Substitution rejected - Use specified materials.

Signed by: _____ Date: _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Procedural requirements for non-administrative submittals including product data, shop drawings, samples and other miscellaneous work-related submittals required by Contract Documents.
- B. Refer to Division 00 and other Division 01 sections and other contract documents for specifications for administrative submittals; such submittals include, but are not limited to following items:
 - 1. Permits.
 - 2. Payment applications.
 - 3. Performance and payment bonds.
 - 4. Insurance certificates.
 - 5. Inspection and test reports.
 - 6. Schedule of values.
 - 7. Progress schedule.
 - 8. Listing or designation of subcontractors.
 - 9. Record drawings
- C. Designate in progress schedule, or in separate coordinated schedule, dates for submission and dates reviewed shop drawings, product data and samples will be needed for each product.
 - 1. Identify items requiring long lead times.
- D. The Contractor's submittal and Architect's acceptance of Product Data, Shop Drawings or Samples that relate to construction activities not complying with Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.
- E. Product Data, Shop Drawing and Sample Submittals containing substitutions for specified items will be rejected and returned as not in compliance with Contract Documents.

1.02 PRODUCT DATA

- A. Product Data includes standard printed information on manufactured products that has not been specially prepared for this Project, including but not limited to following items:
 - 1. Manufacturer's product specifications and installation instructions.
 - 2. Standard color charts.
 - 3. Catalog cuts.
 - 4. Roughing-in Diagram and templates.
 - 5. Standard wiring diagrams.
 - 6. Printed performance curves.
 - 7. Operational range diagrams.
 - 8. Mill reports.
 - 9. Standard product operating and maintenance manuals.

- B. Modify standard drawings to delete information which is not applicable to the Project.
- C. Supplement standard information to provide additional information specifically applicable to Project.
 - 1. Clearly mark each copy to identify pertinent materials, products or models.
 - 2. Show dimensions and clearances required.
 - 3. Show performance characteristics and capacities.
 - 4. Show wiring or piping diagrams and controls.

1.03 SHOP DRAWINGS

- A. Shop drawings are technical drawings and data that have been specially prepared for Project, including but not limited to following items:
 - 1. Fabrication and installation drawings.
 - 2. Setting diagrams.
 - 3. Templates.
 - 4. Patterns.
 - 5. Coordination drawings (for use on-site).
 - 6. Schedules.
 - 7. Design mix formulas.
 - 8. Contractor's engineering calculations.
- B. Standard information prepared without specific reference to Project is not considered to be shop drawings.

1.04 SAMPLES

- A. Samples are physical examples of Work, including but not limited to following items:
 - 1. Partial sections of manufactured or fabricated work.
 - 2. Small cuts or containers of materials.
 - 3. Complete units of repetitively used materials.
 - 4. Swatches showing color, texture and pattern.
 - 5. Color range sets.
 - 6. Units of work to be used for independent inspection and testing.
- B. Office Samples:
 - 1. Provide in specified size and quantity to clearly illustrate:
 - a. Functional characteristics of product or material, with integrally related parts and attachment devices.
 - b. Full range of color, texture, and pattern.
 - 2. Where size and quantity are not specified, provide minimum of four samples, 12 inch by 12 inch minimum size, where samples are required.
- C. Field Samples and Mock-Ups:
 - 1. Erect at Project Site in location acceptable to Architect.
 - 2. Construct each sample or mock-up complete, including work of trades required in finished work.

3. Size or area as specified in respective specification section.
4. Remove mock-ups at conclusion of Work or when acceptable to Architect and dispose legally.

1.05 VERIFIED REPORTS

- A. Submit Verified Reports shall be submitted when required by the Owner, the Inspector of Record, the Architect and/or their Consultants, or as required by regulatory agencies, codes, laws, ordinances, etc.

1.06 DEFERRED APPROVALS

- A. Submit detailed plans, specifications and engineering calculations for Deferred Approval items.
- B. Calculations and drawings of structural nature shall be prepared and signed by registered Structural Engineer licensed in State of California.
- C. Submit 8 sets.
 1. If revisions are necessary, Architect will return one (1) set to contractor.
 2. Resubmit 8 sets with corrections.
- D. Fabrication and installation of Deferred Approval items shall not be started until detailed plans, specifications and engineering calculations have been accepted by Architect, Design Consultants, Building Officials, Regulatory Agencies, and/or Owner.

1.07 MISCELLANEOUS SUBMITTALS WORK-RELATED

- A. Include, but not limited to following types of submittals:
 1. Specially-prepared warranties (guarantees).
 2. Standard printed warranties.
 3. Maintenance agreements.
 4. Printed industry standards.
 5. Collected and bound operating/maintenance manuals.
 6. Keying schedule, keys and other security protection safety devices.
 7. Maintenance tools and spare parts.
 8. Maintenance materials and overrun stock.

1.08 CONTRACTOR RESPONSIBILITIES

- A. As defined in General Conditions.
- B. Review shop drawings, product data and samples for compliance with Contract Documents prior to submission.
- C. Determine and Verify:
 1. Field measurements.
 2. Field construction criteria.
 3. Catalog numbers and similar data.
 4. Conformance with Specifications and Drawings.
- D. Coordinate each submittal with requirements of Work and of Contract documents.
- E. Notify Architect in writing, at time of submission, of deviations in submittals from requirements of Contract Documents.
- F. Do not begin fabrication or work which requires submittals until return of submittals with

Architect's approval.

1.09 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in Work or in work of other contractor.
- B. Coordinate transmittal of different types of submittals for related elements of Work so processing will not be delayed by need to review submittals concurrently for coordination.
 - 1. The Architect reserves right to withhold action on submittal requiring coordination with other submittals until related submittals are received.
- C. Accompany submittals with an accurately completed transmittal form provided in section 01 99 99 - Forms.
 - 1. Submittals not accompanied by such form, or where applicable items on form are not completed, will be returned for resubmittal.
 - a. Sample of transmittal form is included at end of this section.
 - 2. Photo copy related specification section identifying submittal requirements and identify/bubble items that are being submitted.
- D. Use a separate transmittal form for each specific item or class of material or equipment for which submittal is required.
 - 1. Transmittal of submittals on various items using single transmittal form will be permitted only when items taken together constitute manufacturer's package or are so functionally related that expediency indicates review of group or package as whole.
- E. Schedule submissions per the deliverable timelines as specified in section 01 32 16.
 - 1. No extension of Contract Time will be authorized because of failure to transmit submittals to Architect sufficiently in advance of Work to permit processing.
- F. Number of Submittals Required: Submit quantities as follows.
 - 1. Shop Drawings: Submit eight (8) full-sized/legible copies.
 - 2. Product Data: Submit eight (8) copies of manufacturer's product data.
 - 3. Samples: Submit number stated in each specification section, or, if not stated, submit as specified.
 - 4. Warranties, Maintenance Agreements, Industry Standards, and Operating/Maintenance Manuals: Submit four (4) copies.
 - 5. Electronic Copies: Where deemed necessary or applicable to the project, electronic copies may be allowed to be provided in lieu of hard copies. Prior written approval must be granted before electronic copies shall be deemed acceptable. This clause does not apply to samples and/or mock-ups.
- G. Accompany submittals with transmittal form provided by Architect, containing:
 - 1. Date.
 - 2. Project title and number.
 - 3. Contractor's name and address.
 - 4. Number of each shop drawing, product data and sample submitted.
 - 5. Notification of deviations from Contract Documents.
 - 6. Pertinent data.
- H. Submittals shall include:

1. Date and revision dates.
2. Project title and number.
3. Names of:
 - a. Architect/Engineer.
 - b. Contractor.
 - c. Subcontractor.
 - d. Supplier.
 - e. Manufacturer.
 - f. Separate detailer when pertinent.
4. Identification of product or material.
5. Relation to adjacent structure or materials.
6. Field dimensions, clearly identified as such.
7. Specification section number.
8. Applicable standards, such as ASTM number or Federal Specification.
9. A blank space, 8-inch by 3 inch, for Contractor and Architect stamps.
10. Identification of deviations from Contract Documents.
11. On each sheet, provide contractor's stamp, initialed or signed, certifying to review of submittal, verification of field measurements and compliance with Contract Documents.
12. Submittals without Contractor's review stamp on each sheet will be returned, without action, for resubmittal.

1.10 RESUBMISSION REQUIREMENTS

A. Shop Drawings:

1. Revise initial drawings as required and resubmit as specified for initial submittal.
2. Indicate on drawings any changes which have been made or than those requested by Architect.

B. Product Data and Samples: Submit new data and samples as required for initial submittal.

1.11 DISTRIBUTION OF SUBMITTALS AFTER REVIEW

A. Construction Manager to distribute Shop Drawings and copies of Product Data and approved Deferred Approvals (if any), which carry Architect/Engineer stamp, with such reasonable promptness as to cause no delay in Work, but no later than three working days of receipt, to:

1. Job site file.
2. Record Documents file.
3. Prime Contractor.
4. Affected contractors.
5. Owner's Inspector.

B. Prime Contractor is responsible to coordinate distribution to their subcontractors and internal staff.

C. Distribute samples which carry Architect's review stamp as directed by Architect.

1.12 ARCHITECT'S DUTIES

- A. As defined in the General Conditions.
- B. Architect will review submittals as originally submitted, as well as first resubmittal, at Architect's own cost.
 - 1. Architect's cost for reviewing additional resubmittals made or required, will be paid by Owner with reimbursement from Contractor by deductive change order.
- C. Action Stamp: Architect will stamp each submittal with uniform, self-explanatory stamp will be appropriately marked, as follows, to indicate action taken:
 - 1. Final Unrestricted Release: Where submittals are marked "**No Exception Taken**", that part of Work covered by submittal may proceed provided it complies with requirements of Contract Documents; final acceptance will depend upon that compliance.
 - 2. Final-But-Restricted Release: When submittals are marked "**Make Corrections Noted**", that part of Work covered by submittal may proceed provided it complies with notations or corrections on submittal and requirements of Contract Documents; final acceptance will depend on that compliance.
 - 3. Returned for Resubmittal: When submittal is marked "**Rejected**" or "**Revise and Resubmit**", do not proceed with that part of Work covered by submittal, including purchasing, fabrication, delivery, or activity.
 - a. Revise or prepare new submittal in accordance with notations; resubmit without delay.
 - 1) Repeat if necessary to obtain different action mark.
 - 4. Do not permit submittals marked "Rejected" or "Revise and Resubmit" to be used at Project Site, or elsewhere where Work is in progress.
- D. Unsolicited Submittals: Architect will return unsolicited submittals to sender without action.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

3.01 SUBMITTAL FORM

- A. Refer to Section 01 99 99 for required form.

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Following Administrative and Procedural Requirements:

1. Selection of products for use in Project
2. Product delivery, storage, and handling.
3. Manufacturers standard warranties on products.
4. Special warranties.
5. Product substitutions.

1.02 RELATED REQUIREMENTS AND SECTIONS

- A. Instructions to Bidders: Procedures for requesting substitutions during bidding period.
- B. Division 1: Substitution Procedures
- C. Section 01 77 00: Project Closeout Procedures; for submitting warranties for contract closeout.
- D. Divisions 2 through 33 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.03 DEFINITIONS

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

1. Named Products: Items identified by manufacturer’s product name, including make or model number or other designation, shown or listed in manufacturer’s published product literature that is current as of date of Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise.
 - a. Products salvaged or recycled from other projects are not considered new products.

B. Substitutions: Changes in products, materials, equipment, and methods of construction required by Contract Documents and proposed by Contractor; following are not considered substitutions:

1. Substitutions requested during bidding period and accepted by written Addendum prior to opening of bids or award of Contract.
2. Revisions to Contract Documents requested by Owner or Architect.
3. Specified options of products and construction methods included in Contract Documents.
4. Compliance with governing regulations and orders issued by governing authorities.

C. Basis-of-Design Product Specification: Where specific manufacturer’s product is named and accompanied by words “Basis of Design”, including make or model number or other designation, to establish significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of

evaluating comparable products of other named manufacturers. If only one manufacturer is named, it shall be considered the Basis of Design whether designed as the Basis of Design or not.

- D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for particular product and specifically endorsed by manufacturer to Owner.
- E. Special Warranty: Written warranty required by or incorporated into Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.04 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration.

Refer to Specification Section 01 25 00 for Substitution Procedures. The clauses in this Specification is intended to complement the requirements of Specification Section 01 25 00. Where the clauses are in conflict, the more stringent of the two shall apply.

1. Identify product or fabrication or installation method to be replaced.
2. Include Specification Section number and title and Drawing numbers and titles.
 - a. Refer to Article 2.02, in this Section.
3. Substitution Request Form: Use form provided the **architect**; other forms will not be accepted.
 - a. Requests received without properly completed substitution request form will be rejected without further review.
4. Documentation: Show compliance with requirements for substitutions and following, as applicable:
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Product identification, including manufacturer's name and address.
 - c. Coordination information, including list of changes or modifications needed to other parts of Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - d. Detailed comparison of significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - e. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - f. Structural calculations, where applicable or requested, prepared and signed by Structural Engineer licensed in California.
 - g. Samples, where applicable or requested.
 - h. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - i. Material test reports from qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - j. Research/evaluation reports evidencing compliance with building code in effect for Project, from model code organization acceptable to authorities having jurisdiction.
 - k. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for Work, including effect on overall

Contract Time.

- 1) If specified product or method of construction cannot be provided within Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
 - l. Cost information, including proposal of change, if any, in Contract Sum.
 - m. Designation of availability of maintenance services, sources of replacement materials.
 - n. Contractor's certification that proposed substitution complies with requirements in Contract Documents and is appropriate for applications indicated.
 - o. 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.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00.
1. Show compliance with requirements.

1.05 QUALITY ASSURANCE

- A. To fullest extent possible, provide products of same kind, from single source.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle products using means and methods that will prevent damage, deterioration and loss, including theft; comply with manufacturer's written instructions.
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 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 ensure compliance with Contract Documents, and to ensure products are undamaged and properly protected.
 5. Store products in manner to facilitate inspection and measurement of quantity or counting of units.
 6. Store materials in manner that will not endanger Project structure.
 7. Store products subject to damage by elements under cover in weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 9. Protect stored products from damage.

1.07 PRODUCT WARRANTIES

1. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by Contract Documents.
 1. Manufacturer's disclaimers and limitations on product warranties do not relieve

Contractor of obligations under requirements of Contract Documents.

2. Special Warranties: Prepare written document that contains appropriate terms and identification, ready for execution.
 1. Submit draft for approval before final execution.
 2. Manufacturer's Standard Form: Modified to include Project specific information and properly executed.
 3. Refer to Division 2 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.
3. Submittal Time: Comply with requirements in Section 01 77 00.

PART 2 – PRODUCTS

2.01 PRODUCT SELECTION

- A. General: Provide products that comply with Contract Documents, are undamaged, and unless otherwise indicated, that are new (not previously installed) at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, safety guards and other items needed for 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 right to limit selection to products with warranties not in conflict with requirements of Contract Documents.
 4. Where products are accompanied by term "as selected", Architect will make selection.
 5. Where products are accompanied by term "match sample", sample to be matched is Architect's.
 6. Descriptive, performance, and reference standard requirements in Specifications establish salient characteristics of products.
 7. Or Equal: Where products are specified by name and accompanied by term "or equal" or "or approved equal" or "or approved", comply with provisions in Product Substitutions Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures: Procedures for product selection include following:
 1. Product: Where Specification paragraphs or subparagraphs titled Product name single product and manufacturer, provide product named.
 - a. Substitutions may be considered, unless otherwise indicated.
 2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled Manufacturer or Source name single manufacturers or sources, provide product by manufacturer or from source named that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.
 3. Products: Where Specification paragraphs or subparagraphs titled Products introduce list of names of both products and manufacturers, provide one of products listed that complies with requirements.
 - a. Where products or manufacturers are specified by name, accompanied by term "or equal", or "or approved equal" comply with provisions in "Product Substitutions" Article to obtain approval for use of an unnamed product.

4. **Manufacturers:** Where Specification paragraphs or subparagraphs titled “Manufacturers” introduce list of manufacturers names, provide product by one of manufacturers listed that complies with requirements.
 - a. Where manufacturers are specified by name, accompanied by term “or equal”, or “or approved equal” comply with provisions in Product Substitutions Article to obtain approval for use of an unnamed product.
5. **Product Options:** Where Specification paragraph titled Product Options indicate that size, profiles, and dimensional requirements on Drawings are based on specific product or system, provide either specific product or system indicated or comparable product or system by another manufacturer.
 - a. Comply with provisions in Product Substitutions Article to obtain approval for use of unnamed product and/or manufacturer.
6. **Basis-of-Design Products:** Where Specification paragraphs or subparagraphs titled Basis-of-Design Product are included and also introduce or refer to list of manufacturers names, provide either specified product or comparable product by one of other named manufacturers.
 - a. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on product named.
 - b. Comply with provisions in Product Substitutions Article to obtain approval for use of unnamed product.
 - c. Substitutions may be considered.
7. **Visual Matching Specification:** Where Specifications require matching established Sample, select product and manufacturer that complies with requirements and matches Architect’s sample.
 - a. Architect’s decision will be final on whether proposed product matches satisfactorily.
 - b. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of Contract Documents on substitutions for selection of matching product.
8. **Visual Selection Specification:** Where Specifications include phrase as selected from manufacturer’s colors, patterns, textures, or similar phrase, select product and manufacturer that complies with other specified requirements.
 - a. **Standard Range:** Where Specifications include phrase standard range of colors, patterns, textures or similar phrase, Architect will select color, pattern, or texture from manufacturer’s product line that does not include premium items.
 - b. **Full Range:** Where Specifications include phrase full range of colors, patterns, textures or similar phrase, Architect will select color, pattern, or texture from manufacturer’s product line that includes both standard and premium items.
9. **Performance Specification Requirements:** Where Specifications require compliance with performance requirements, provide products that comply with requirements, and are recommended by manufacturer for application indicated.
 - a. General overall performance of product is implied where product is specified for specific application.
 - b. Manufacturer’s recommendations may be contained in product literature, or by manufacturer’s certification of performance.

2.02 PRODUCT SUBSTITUTIONS

- A. Timing: Substitutions are restricted to before bid opening if stated in the bidding documents. Acceptable substitutions prior to bid shall be communicated **ONLY** through addenda.
1. Requests for substitutions received after that time may be considered or rejected at discretion of Architect.
 2. Requests for substitutions **MAY** be considered if received within 15 days after award of Contract, subject to specified submittal requirements and following:
 - a. Architect will consider request for substitution after commencement of Work, within 15 days after award of Contract, only if specified product or construction method cannot be provided within Contract Time, cannot receive necessary approvals, cannot be provided in manner compatible with or coordinate with other materials or cannot provide required warranty.
 - b. Contractor's base bid **MUST** include the specified product. If the substitution is accepted after the Notice of Award, the owner receives full benefit of the cost reduction.
 - c. Requests received more than 15 days after award of contract will only be considered in case of substantiated product unavailability, or conditions beyond control of Contractor.
- B. Conditions: Contractor's substitution request will be received and considered by Architect when following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action except to record noncompliance with these requirements; burden of proof of merit of proposed substitution is upon proposer.
1. Extensive revisions to Contract Documents are not required Requested substitution is consistent with Contract Documents and will produce indicated results.
 2. Request is timely, fully documented and properly submitted.
 3. Request is directly related to "or equal" clause or similar language in Contract Documents.
 4. Request is directly related to "or equal" clause or similar language in Contract Documents.
 5. Specified product or construction method cannot be provided within Contract Time.
 - a. Request will not be considered if product or method cannot be provided as result of failure to pursue Work promptly, failure to identify items requiring long lead times, or failure to coordinate activities properly.
 6. Specified product or construction method cannot receive necessary approval by governing authority, and requested substitution can be approved.
 7. Substantial advantage is offered Owner, in cost, time, energy conservation, or other considerations of merit, after deducting additional responsibilities Owner must assume.
 - a. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner or separate Contractors, and similar considerations.
 8. Specified product or construction method cannot be provided in manner that is compatible with other materials, and where Contractor certifies that requested substitution will overcome incompatibility.
 9. Specified product or construction method cannot be coordinated with other materials, and where Contractor certifies that requested substitution can be coordinated.

10. Specified product or construction method cannot provide warranty required by Contract Documents and where Contractor certifies that requested substitution provide required warranty.
 11. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of Work, is uniform and consistent, is compatible with other products, and is acceptable to contractors involved.
- C. Architects Action: If necessary, within one week of receipt of request for substitution, Architect will request additional information or documentation for evaluation of request for substitution.
1. Within 2 weeks of receipt of request, or one week of receipt of additional information or documentation, whichever is later, Architect will notify Contractor of acceptance or rejection of requested substitution.
 2. Use product specified if Architect cannot make decision on use of proposed substitution within time allocated.
 3. Architect will not be responsible for locating or securing information which is not included in substantiating data.
 4. Architect's decision of acceptance or rejection of requested substitution shall be final.
- D. Architect's cost for evaluating substitutions requested by Contractor, including making subsequent revisions to drawings, specifications and other resulting documentation, will be paid by Owner with reimbursement from Contractor by deductive change order.
- E. Contractor's submittal and Architect's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.
- F. Forms of Acceptance for Substitutions:
1. During Bidding Process: Addendum
 2. After Award of Contract: Change Order.

PART 3 – EXECUTION

NOT USED

END OF SECTION

SECTION 01 66 00

PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 DESCRIPTION

Work Included: Provide products scheduled for use in the Work by means including, but not necessarily limited to, those described in this Section.

1.03 QUALITY ASSURANCE

Include within the Contractor's quality assurance program such procedures as are required to assure full protection of work and materials.

1.04 MANUFACTURERS' RECOMMENDATIONS

Except as otherwise accepted by the Architect, determine and comply with manufacturers' recommendations on product handling, storage, and protection.

1.05 PACKAGING

A. Deliver products to the job site in their manufacturer's original container, with labels intact and legible.

1. Maintain packaged materials with seals unbroken and labels intact until time of use.

2. Promptly remove damaged material and unsuitable items from the job site, and promptly replace with materials meeting the specified requirements, at no additional cost to the Owner.

B. The Architect may reject as non-complying such material and products that do not bear identification satisfactory to the Architect as to manufacturer, grade, quality, and other pertinent information.

1.06 PROTECTION

A. Protect finished surfaces, including jambs and soffits of openings used as passageways, through which equipment and materials are handled.

B. Provide protection for finished floor surfaces in traffic areas prior to allowing equipment or materials to be moved over such surfaces.

C. Maintain existing surfaces to remain and finished surfaces clean, unmarred, and suitably protected until accepted by the Owner.

1.07 REPAIRS AND REPLACEMENTS

A. In event of damage, promptly make replacements and repairs to the acceptance of the Architect and at no additional cost to the Owner.

B. Additional time required to secure replacements and to make repairs will not be considered by the Architect to justify an extension in the Contract Time of Completion.

END OF SECTION

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.

1.03 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.04 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or those results in increased maintenance or decreased operational life or safety.
 - 1. Primary operational systems and equipment.
 - 2. Air or smoke barriers.
 - 3. Fire-protection systems.
 - 4. Control systems.
 - 5. Communication systems.
 - 6. Electrical wiring systems.
- C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 1. Water, moisture, or vapor barriers.
 - 2. Membranes and flashings.
 - 3. Exterior curtain-wall construction.
 - 4. Equipment supports.
 - 5. Piping, ductwork, vessels, and equipment.
 - 6. Noise- and vibration-control elements and systems.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.05 WARRANTY

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

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. 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.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize interruption of services to occupied areas.

3.03 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size

required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in the technical specifications where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Where directed by drawings or specifications, cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather tight condition.

END OF SECTION

SECTION 01 77 00

PROJECT CLOSEOUT

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This Section specifies administrative and procedural requirements for project closeout, including but not limited to:
 - 1. Inspection procedures.
 - 2. Project record document submittal.
 - 3. Operating and maintenance manuals submittal.
 - 4. Submittal of warranties.
- B. Closeout requirements for specific construction activities are included in the appropriate Sections in the technical specification sections.
- C. Refer to section 01 99 99 for an acceptable binder cover page template.

1.02 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.
 - 1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Price.
 - a. 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.
 - 2. Advise the Construction Manager of pending insurance change-over requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.
 - 4. Obtain and submit releases enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
 - 5. Deliver tools, spare parts, extra stock, and similar items.
 - 6. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mockups, and similar elements.
 - 7. Complete final clean up requirements.
- B. Inspection Procedures: On receipt of request for inspection, the Architect and/or Engineer will either proceed with inspection or advise the Contractor of unfulfilled requirements. The Architect and/or Engineer will prepare the Certificate of Substantial Completion following inspection, or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.
 - 1. The Architect and/or Engineer will repeat inspection when requested and assured that the Work has been substantially completed.
 - 2. Results of the completed inspection will form the basis of requirements for final acceptance.

1.03 RECORD DOCUMENT SUBMITTALS

- A. General: Do not use record documents for construction purposes; protect from deterioration and

loss in a secure, fire-resistive location; provide access to record documents for the Architect and/or Engineer's reference during normal working hours.

- B. **As-Built Drawings:** Produce and maintain a clean, undamaged set of "E" size Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies from the Work as originally shown. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
1. Mark changes to the Documents caused by RFI responses with RFI designation.
 2. Mark changes to the Documents caused by Bulletins with Bulletin designation.
 3. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
 4. Note related Change Order numbers where applicable.
 5. Organize As-Built drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
 6. Per Building Official Plan Check Requirements, "As-Built" drawing requirements are as follows:
 - As-built drawings are the final set of drawings produced at the completion of a construction project. They include all the changes that have been made to the original construction drawings, including notes, modifications, revisions and any other information that should be included. As-built drawings should not change the design intent but should depict the actual as-built conditions of the completed construction. While the original drawings are typically produced using computer aided design (CAD) software, the as-built drawings should contain handwritten notes, sketches, and changes.
 - When the construction phases of the project / contract are finished a complete set of marked-up redlined drawings will be turned over to the Owner for review and approval. All markings shall be on a previous approved set of drawings, signed and stamped by the EOR and Jurisdiction Enforcement Agency. No additional PE seal or signature is required on the as-built drawings. These drawings shall have AS-BUILT DRAWINGS indicated on the title sheet in the title block and on each sheet of submitted as-built drawings along with initial of responsible individual.
- C. **Record Specifications:** Maintain one complete copy of the Project Manual, including addenda, and one copy of other written Construction Documents such as Change Orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and Product Data.
1. Upon completion of the Work, submit record Specifications to the Owner's Representative for approval and corrections. Upon acceptance, resubmit for the Owner's use.
- D. **Record Product Data:** Maintain one copy of each Product Data submittal. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site, and from the manufacturer's installation instructions and recommendations. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation. Note related Changes Orders and markup of record drawings and Specifications.
1. Upon completion of markup, submit complete set of record Product Data to the Owner's Representative for approval and correction. Upon acceptance, resubmit for the Owner's use.
- E. **Miscellaneous Record Submittals:** Refer to other Specification Sections for requirements of miscellaneous recordkeeping and submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records

and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Owner's Representative for approval and correction. Upon acceptance, resubmit for the Owner's use.

- F. Maintenance Manuals: Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 2 inch, 3-ring vinyl covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Submit one complete set of original manufacturer's maintenance and operational manuals to the Owner's Representative for approval and corrections. Upon acceptance, resubmit for the Owner's use a minimum of four (4) complete original manufacturer's sets. Include the following types of information:
1. Emergency instructions.
 2. Spare parts list.
 3. Copies of warranties.
 4. Wiring diagrams.
 5. Recommended "turn around" cycles.
 6. Inspection procedures.
 7. Shop Drawings and Product Data.
 8. Manufacturer Contact Information
 9. Prime Contractor Contact Information

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 CLOSEOUT PROCEDURES

- A. Operating and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:
1. Maintenance manuals.
 2. Record documents.
 3. Spare parts and materials.
 4. Tools.
 5. Lubricants.
 6. Fuels.
 7. Identification systems.
 8. Control sequences.
 9. Hazards.
 10. Cleaning.
 11. Warranties and bonds.

END OF SECTION

SECTION 01 78 36

WARRANTIES

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.
- B. Refer to the General Conditions for terms of the Contractor's special warranty of workmanship and materials.
- C. Provide one (1) year warranty for workmanship, product and materials **unless** noted differently in the respective specification section.
- D. Certifications and other commitments and agreements for continuing services to the Owner are specified elsewhere in the Contract Documents.
- E. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.
- F. Further to Item E above, it is specifically required and acknowledged by this Contractor that warranty periods on all equipment commences from date of **Owner's acceptance of the equipment and/or from the date of Substantial Completion**, whichever is later. Therefore, startup of equipment and/or the use of equipment during construction shall not be construed as the qualifier for warranty period start.

1.02 DEFINITIONS

- A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
- B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.03 WARRANTY REQUIREMENTS

- A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.
- D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- E. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entitles required to countersign such commitments are willing to do so.

1.04 SUBMITTALS

- A. Submit written warranties to the Owner's Representative prior to the date certified for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Engineer.
 1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Engineer within fifteen days of completion of that designated portion of the Work.
- B. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner through the Owner's Representative for approval prior to final execution.
- C. Form of Submittal: At Final Completion compile four (4) copies of each required warranty and bond properly executed by the Contractor, or by the Contractor's subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual. Use a form acceptable to the Owner.
- D. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8½ inch by 11-inch paper.
 1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the 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 the installer.
 2. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS", the Project title or name, and the name of the Contractor. Refer to section 01 99 00 for an acceptable closeout cover page template.
 3. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

END OF SECTION

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Requirements apply to this Section.

1.02 SCOPE OF WORK SUMMARY

- A. Furnish all labor and equipment necessary to perform demolition and site clearing work as shown on drawings and specified herein, including removal of slabs, curbs, walls, partitions, fixtures, finishes, and other items as indicated and required for new construction.
- B. Protect all existing installations from damage. Take measures to prevent damage to existing facilities and finishes during demolition and construction.
- C. Carefully remove items which are to remain property of Owner, and store in secure, dry area for later reuse.
- D. Salvaged Material (not wanted by Owner): Items which the Owner does not want and is of salvable value to Contractor may be removed from structure as work progresses. Owner and CBC 2016 require a minimum of 50% (by weight) of all non-hazardous construction materials be recycled, composted and/or salvaged.
- E. Related Work Specified elsewhere:
 - 1. Disconnecting and capping existing gas, water, sewer and electrical utilities is included under other Divisions. Coordinate with work under these Divisions to make sure their work is complete before starting demolition work affecting these utilities.
 - 2. Removal of Plumbing: Division 22.
 - 3. Removal of Mechanical: Division 23.
 - 4. Removal of Electrical: Division 26.

1.03 STANDARDS AND REFERENCES

A. Definitions:

- 1. Except for items or materials indicated to be reused, salvaged or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition by the Contractor(s) in a legal disposal area appropriate to the materials being disposed
- 2. "Remove": Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.
- 3. "Removed and salvaged": Items to remain the Owner's property shall be removed, cleaned, and packed or crated to protect against damage. Identify contents and deliver to Owner's designated storage area.
- 4. "Existing to Remain" Protect construction indicated to remain against damage and soiling during demolition. When permitted by the Architect, items may be removed to a suitable, protected storage location during demolition and then cleaned and reinstalled in their original locations.
- 5. "Remove and Reinstall": Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in locations indicated.

- B. Codes and Regulations: Demolition work shall comply with local ordinances and Safety Codes of State of California and rules and regulations of Industrial Accident Commission of State of California' applicable to demolition work.

1.04 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Engage an experienced firm that has successfully completed demolition work similar to that indicated for this Project.
- B. Safety Precautions: Perform demolition work in such a manner as to prevent damage to existing facilities to remain or to be salvaged, and to prevent injury to public and workmen engaged on site under this or other contracts.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

- A. Submit according to the requirements of Section 01 33 00 Submittal Procedures.
- B. Proposed Dust Control Measures.
- C. Proposed Noise Control Measures.
- D. Schedule of demolition activities indicating the following:
 - 1. Detailed sequence of demolition, salvage, and removal work, with starting and ending dates for each activity.
 - 2. Dates for shutoff, capping, and continuation of utility services.
- E. Salvage Plan - Inventory of items to be removed and salvaged. Salvage plan shall show how all materials are to be sorted, salvaged and recycled. Plan must include all final destinations for each type of material.
 - 1. Contractor shall submit salvage plan showing how all materials are to be sorted, salvaged and recycled. Plan must include all final destinations for each type of material.
 - 2. Salvaged items must be transported from site as they are removed, unless materials are to be reused on site.
 - 3. Storage or sale of removed items on site will not be permitted, unless materials are to be reused on site.
 - 4. Contractor shall provide certification for all salvaged materials. Certifications may take the form of receipts from recycling facilities, manufacturers, or any other legitimate form of certification. Certification types shall be outlined in salvage plan and approved by Owner.
- F. Inventory of items to be removed and salvaged, and deliver to Owner's designated storage area.
- G. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and improvements that might be misconstrued as damage caused by demolition operations.
- H. Pre-Demolition Conference: Conduct conference at Project site with Owner, Architect and Construction Manager

1.07 DELIVERY, STORAGE, AND HANDLING

Comply with the requirements of Section 01 66 00 Product Storage and Handling Requirements.

1.08 RECORD DRAWINGS

Comply with the requirements of Section 01 77 00 Project Closeout.

1.09 WARRANTY

Provide manufacturer's standard warranty in accordance with Section 01 78 36 Warranties.

PART 2 – PRODUCTS

Not applicable

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which work of this Section will be performed.
- B. Confirm existing conditions and correlate with requirements indicated to determine extent of demolition required.
- C. Inventory and record the conditions of items to be removed and reinstalled and items to be removed and salvaged.
- D. Correct conditions detrimental to timely and proper completion of the Work.
- E. Do not proceed until unsatisfactory conditions are corrected.
- F. Beginning of installation means acceptance of conditions.
- G. Confirm condition of the building to determine whether removing any element might result in a structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during demolition.
- H. Perform surveys as the Work progresses to detect hazards resulting from demolition activities.

3.02 PREPARATION

- A. Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
- B. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
- C. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around demolition area.
 - 1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
- D. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of building to remain.
- E. Strengthen or add new supports when required during progress of demolition.

3.03 SCHEDULING

- A. Protect all existing installations from damage. Take measures to prevent damage to existing facilities and finishes during demolition and construction.

- B. Arrange demolition and salvage schedule so as not to interfere with Owner's on-site operations.

3.04 ITEMS REMOVED BY CONTRACTOR AND RETAINED BY OWNER

General: Items noted on drawings shall be removed without damage and turned over to Owner. Coordinate with Owner and arrange for designated storage area.

3.05 UTILITY SERVICES

- A. Utility Requirements: Refer to Division 21 through Division 26 sections for shutting-off, disconnecting, removing, and sealing or capping utility services. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.
- B. Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.
- C. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by Owner, and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to governing authorities.
- D. Provide not less than 72 hours notice to Owner if shutdown of service is required during changeover.

3.06 EXPLOSIVES

The use of explosives will not be permitted.

3.07 POLLUTION CONTROLS

- A. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.
- B. Do not create hazardous or objectionable conditions, such as flooding, and pollution, when using water.
- C. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- D. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level.
- E. Clean adjacent buildings and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before start of demolition.

3.08 DEMOLITION

- A. Demolish concrete and/or asphalt paving, and densified granite surfaces, as required to prepare for new construction.
- B. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.
- C. Fill below-grade areas and voids resulting from demolition of building elements and pavements and soil materials according to requirements of Division 31.
- D. Promptly repair damages to adjacent facilities caused by demolition operations.
- E. Wherever cutting and removal of portions of existing work is indicated, such work shall be sawn in a manner that will produce neat and straight lines, parallel to adjacent surfaces or plumb for vertical surfaces. Execute cutting and demolition by methods which will prevent damage to other work, and which will provide proper surfaces to receive installation of repairs and new work.

3.09 DISPOSAL OF DEMOLISHED MATERIALS

- A. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Removal: All materials resulting from demolition work, except those items specifically listed to be retained by Owner, shall become property of contractor and shall be removed from premises. All material to be removed needs to be out of the area as scheduled.
 - 1. Establish haul routes in advance and post flagmen to assure safety of public and workmen.
 - 2. Keep streets (and facilities) free of mud, rubbish, etc. Assume responsibility for any damage resulting from hauling operations and hold Owner free and clear of any liability in connection therewith.
- C. Burning demolished materials is not allowed.
- D. Transport demolished materials off Owner's property and legally dispose of these materials.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Formwork for cast-in-place concrete, with shoring, reshoring, bracing and anchorage.
- B. Openings for other work.
- C. Form accessories.
- D. Form stripping.

1.03 RELATED REQUIREMENTS

- A. Section 03 20 00 - Concrete Reinforcing.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 05 12 00 - Structural Steel Framing.

1.04 REFERENCE STANDARDS

- A. Utilize the edition of the listed document as identified in the "Design Criteria Notes" in the structural drawings. If not listed in the "Design Criteria Notes", use the edition adopted or referenced by the listed governing building code or material standard. If no specific edition is adopted, use the latest edition.
 - 1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 - Specifications for Concrete Construction.
 - 3. ACI 303R - Guide to Cast-In-Place Architectural Concrete Practice.
 - 4. ACI 318 - Building Code Requirements for Structural Concrete.
 - 5. ACI 347R - Guide to Formwork for Concrete.
 - 6. ACI 347.2R – Guide for Shoring/Reshoring of Concrete Multi-story Buildings.

1.05 SUBMITTALS

- A. See Division 01 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data and installation requirements for the following:
 - 1. Tie rods and spreaders.
 - 2. Formwork for exposed concrete.
 - 3. Form coatings and release agents.

1.06 QUALITY ASSURANCE

- A. Perform work of this section in accordance with all requirements of ACI 347R and ACI 318 Chapter 26.
- B. Delegated Designer Qualifications: Design formwork and shoring under direct supervision of a Professional Engineer experienced in design of concrete formwork and licensed in the State in which the Project is located.

- C. Concrete formwork and shores shall be designed and constructed to safely support fluid concrete and superimposed construction loads without excessive deflection or concrete leakage. Provide bracing to maintain accurate alignment and to resist all anticipated lateral loads. Forms shall conform with drawings as to shape, line, and dimension. Design, engineering, and construction of forms, shoring, and reshoring shall be the Contractor's responsibility. The Contractor shall also be responsible for determining when temporary supports, shores, reshores, backshores and other bracing may be safely removed.
- D. Formwork for exposed concrete shall be constructed to the tolerances specified in ACI 303R.
- E. Cooperate and coordinate with other trades who furnish and/or install piping, conduit, reglets, anchors, inserts, sleeves, hangers, etc., as their work requires, including provisions for recesses and chases.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver prefabricated forms and installation instructions in manufacturer's packaging.
- B. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.
- C. Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from moisture.
- D. Protect plastic foam products from damage and exposure to sunlight.

PART 2 PRODUCTS

2.01 FORMWORK – GENERAL

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.
- C. Chamfer outside corners of beams, joists, columns, and walls, unless otherwise noted.
- D. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.
- E. Comply with relevant portions of ACI 347R, ACI 301, and ACI 318.
- F. Use the following form types:
 - 1. Concrete not exposed to view: APA Plyform, steel, or clean and sound 1x8 sawn lumber.
 - 2. Smooth Concrete exposed to view: APA Plyform or steel
 - 3. Fiber Forms: Tubular column type spirally constructed of laminated plies of fiber
 - 4. Elevated Floor/Roof Slabs: At discretion of the Contractor.
 - 5. Extruded Polystyrene Foam: board or shaped as required.
 - 6. Form types for concrete exposed to view shall be submitted to and reviewed by the Architect.

2.02 WOOD FORM MATERIALS

- A. Plywood: 5/8-inch minimum APA Plyform.
- B. Lumber: Douglas-Fir species; Standard grade; with grade stamp clearly visible.

2.03 FIBER FORMS

- A. Manufacturers:

1. Sonoco Products Company, Sonotube.
 2. Burke Company, Burke Smoothtube.
 3. Substitutions: See Division 01 – Product Requirements.
- B. Material shall be of round, spirally wound laminated fiber using a non-water sensitive adhesive and surface wax impregnated for moisture protection, surface treated with release agent, non-reusable, of sizes indicated. Forms shall give a smooth and seamless appearance to the cast concrete. Provide reveals as shown on the Drawings.

2.04 EXTRUDED POLYSTYRENE FOAM FORMWORK

- A. Manufacturers: Comply with ASTM C578 type IV
1. Dow Chemical Corp., Styrofoam.
 2. UC Industries, Foamular.
 3. Substitutions: See Division 01 – Product Requirements.

2.05 FORMWORK ACCESSORIES

- A. Form Ties:
1. Concrete exposed to view: Snap ties allowing full 1-inch back break.
 2. Concrete not exposed to view: Snap ties or wire.
 3. Verify special spacing requirements with architectural drawings at exposed concrete.
- B. Form Clamps:
1. Assembly to have cone washers allowing full 1-inch back break; 3/8" center rod.
- C. Spreaders: metal (no wood)
- D. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
1. Do not use materials containing diesel oil or petroleum-based compounds. Form coating containing mineral oils or other non-drying materials will not be permitted for any concrete work.
 2. Composition: Colorless, reactive, water-based compound.
 3. Products:
 - a. Kaufman Products Inc., FormKote Emulsion.
 - b. Nox-Crete Inc., BIO-NOX.
 - c. SpecChem, LLC, Bio Strip WB (water-based).
 - d. W. R. Meadows, Inc., Duogard II (water-based).
 - e. Substitutions: See Division 01 – Product Requirements.
- E. Dowel Sleeves: Plastic sleeve and nailable plastic base for smooth, round, steel load-transfer dowels.
1. Manufacturers:
 - a. BoMetals, Inc.
 - b. Substitutions: See Division 01 – Product Requirements.
- F. Filler Strips for Chamfered Corners: Rigid plastic or wood type; 3/4 x 3/4 inch size unless noted otherwise on the Drawings.

- G. Joint tape: Plastic film tape 3 inches wide.
 - 1. Manufacturers:
 - a. 3M Company, No. 471 plastic film tape.
- H. Expansion Joint Filler (preformed): ½" thick
 - 1. Manufacturers:
 - a. W.R. Meadows, Inc., Sealtight Fiber Expansion Joint.
- I. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
- J. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 05 12 00.
- K. Waterstops:
 - 1. Configuration: As indicated on the Drawings.
 - 2. Size: As indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions and elevations agree with drawings.

3.02 EARTH FORMS

- A. Earth forms are not permitted, except as specifically indicated on approved drawings and as indicated below.
 - 1. Concrete footings may be poured directly against cut earth where excavations are deemed stable by a representative of the geotechnical engineer.
 - 2. See Structural drawings for requirements for placing concrete footings directly against earth without forms.
- B. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

3.03 ERECTION – FORMWORK

- A. Erect and maintain formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, locations, grades, level and plumb work in finished structures. Provide for openings, offsets, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of concrete.
- C. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads. Ensure forms are tied, clamped, and braced to prevent spreading, shifting, or settling.
- D. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- E. Install permanent insulated foam panel formwork per manufacturer's recommendations.

- F. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- G. Align joints and make water-tight. Keep form joints to a minimum.
- H. Obtain approval before framing openings in structural members that are not indicated on drawings.
- I. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.
- J. Coordinate this section with other sections of work that require attachment of components to formwork.
- K. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

3.04 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.05 CONSTRUCTION JOINTS

- A. Refer to Specification 03 30 00 Section 3.05.

3.06 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete. All such items shall be secured into position before the concrete is placed.
- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
 - 1. The Contractor shall ensure that sleeves have been installed and other provisions have been made for the installation of mechanical, electrical and other equipment.
 - 2. Coordinate with all trades to ensure proper placement of all items in forms and to provide proper blockouts wherever required.
- D. Position recessed anchor slots for brick veneer masonry anchors to spacing and intervals as required for the specified product.
- E. Install accessories in accordance with manufacturer's instructions so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- F. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement. Heat seal joints so they are water-tight.
- G. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- H. Close temporary openings with tight fitting panels flush with inside face of forms and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.07 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean and protect permanent foam panel formwork per manufacturer's recommendations.

- C. Clean formed cavities of debris prior to placing concrete.
 - 1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
 - 2. No wooden ties or blocking shall be left in concrete except where indicated for attachment of other work.

3.08 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.
- B. Construct permanent insulated foam panel formwork to maintain tolerances required by ACI 301.
- C. Construct and align formwork for elevator hoistway in accordance with ASME A17.1.
- D. Camber slabs and beams in accordance with ACI 301.
- E. The Owner shall hire an independent qualified surveyor to verify the proper form, line, position, and elevation of the finished concrete work. The results of each survey shall be sent to the Owner, Architect, Engineer of Record, and Contractor and shall identify any deviation from specified tolerances. All work not in conformance with specified tolerances shall be removed at the Contractor's sole expense if so specified by the Owner.

3.09 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Division 01 - Quality Requirements.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.
 - 1. Notify the Architect at least 48 hours in advance of the beginning of pouring operations and at the completion of formwork and location of all construction joints. An inspection of forms and joints will be made for approval of finished work and general layout only. The foregoing inspection shall in no way relieve the Contractor of responsibility of design and safety of formwork, bulkheads and shoring.
 - a. Concrete work out of alignment, level or plumb will be cause for rejection of the whole work affected and, if so rejected, such work shall be removed and replaced, as directed by Architect, with no additional cost to the Owner.
- C. Thoroughly clean and patch all holes in formwork and re-coat as required before reusing. Forms not suited to obtain concrete surfaces and tolerances in conformity with Contract requirements will be rejected by Architect.
 - 1. Reuse of forming materials shall be limited only as required to produce the finishes as specified, free from blemishes and other defects unless covered by other building materials in which case blemish free concrete is not required.

3.10 SHORES AND RESHORES

- A. Comply with ACI 318, ACI 347.2R, and ACI 301 for design, installation, and removal of shoring and reshoring.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.11 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
 - 1. Formwork and shoring shall remain in place until concrete has cured sufficiently to avoid damage during form removal. The Contractor or their representative in charge of concrete construction shall be present during removal of forms and shores and shall be personally responsible for safety of this operation at all times and under all conditions.
 - 2. Shores must be immediately replaced with reshores in a sequence designed to avoid inducing stress in the concrete member.
- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.
- D. Surfaces to be painted shall be smooth and free of substances such as dirt, wax, excessive laitance, grease or materials that would prevent proper bonding of finishes.
 - 1. Removal of foregoing contaminants and complete removal of parting and curing compounds affecting proper paint bond, shall be responsibility of this Section of Work. Sandblast cleaning shall not be employed without specific approval of Structural Engineer.
- E. Upon completion of this Work, clean up and remove from Site all equipment and debris resulting from this work.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete and/or concrete unit masonry.
- B. Supports and accessories for steel reinforcement.

1.03 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 03 30 00 - Cast-in-Place Concrete.

1.04 REFERENCE STANDARDS

- A. Utilize the edition of the listed document as identified in the "Design Criteria Notes" in the structural drawings. If not listed in the "Design Criteria Notes", use the edition adopted or referenced by the listed governing building code or material standard. If no specific edition is adopted, use the latest edition.
 - 1. ACI 117 – Specification for Tolerances for Concrete Construction and Materials
 - 2. ACI 301 - Specifications for Concrete Construction.
 - 3. ACI 315R - Guide to Presenting Reinforcing Steel Design Details.
 - 4. ACI 318 - Building Code Requirements for Structural Concrete.
 - 5. ACI SP-66 - ACI Detailing Manual.
 - 6. ASTM A82 - Cold Drawn Wire for Concrete Reinforcement.
 - 7. ASTM A184 - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
 - 8. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 9. ASTM A704 - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
 - 10. ASTM A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
 - 11. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
 - 12. ASTM A775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
 - 13. ASTM A884 - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
 - 14. ASTM A1035 - Standard Specification for Deformed and Plain, Low-Carbon, Chromium, Steel Bars for Concrete Reinforcement.
 - 15. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - 16. ASTM D3963 - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars.
 - 17. AWS B2.1 - Specification for Welding Procedure and Performance Qualification.
 - 18. AWS D1.4 - Structural Welding Code - Steel Reinforcing Bars.
 - 19. CRSI (DA4) - Manual of Standard Practice.
 - 20. CRSI (P1) - Placing Reinforcing Bars.
 - 21. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.

SUBMITTALS

- A. See Division 01 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Prepare in accordance ACI 315 and ACI SP-66 and CRSI standards. Indicate bending diagrams, assembly diagrams, splicing and laps of bars and shapes, dimensions and details of bar reinforcing and assemblies.
 - 1. The correctness of all reinforcing requirements and work is the responsibility of the Contractor.
 - a. Identify such shop drawings with reference thereon to sheet and detail numbers from Contract Drawings.
 - b. Direct copies of the contract documents are not acceptable as a submission from the Contractor.
 - c. Do not use scaled dimensions from Contract Drawings in determining the lengths of reinforcing bars.
 - d. No reinforcing steel shall be fabricated without approved shop drawings.
 - e. Any deviations from the contract documents must be clearly indicated as a deviation on the shop drawings.
 - f. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Include any welding to be done.
 - g. Shop drawings shall make it clear where each bar is located. Beams, grade beams and walls shall be shown in elevation. On elevations show locations of sleeves and penetrations.
 - h. Check architectural, structural, mechanical, and electrical and other contract documents for anchor bolt schedules and locations, anchors, inserts, conduits, sleeves, and any other items which are required to be cast in concrete, and make necessary provisions as required so that reinforcing steel will not interfere with the placement of such embedded items.
 - i. Show all areas of congestion. Identify where reinforcing steel will interfere with the placement of embedded items such as anchor bolts, anchors, inserts, conduits, sleeves and any other items which are required to be cast in concrete.
- C. Submit shop drawings indicating which members will use fusion welding process for assembly. Shop drawings shall show complete structural details indicating the size of stirrups, the size of holding wires, and welding requirements.
- D. Submit International Code Council (ICC) Evaluation Service Reports indicating approval from ICC Evaluation Service, Inc. for mechanical splices, hooked anchorage systems, large-headed stud punching shear reinforcement and dowel bar replacement systems.
- E. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.
 - 1. Reinforcing Bars
 - 2. Welded Wire Fabric
 - 3. Welding Electrodes
 - 4. Fiber Reinforcement
- F. Product Data:
 - 1. Manufacturer's specifications and installation instructions for splice devices.
 - 2. Bar Supports.
- G. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1 and dated no more than 12 months before start of scheduled welding work.
- H. Reports: Submit certified copies of mill test report of reinforcement material chemical and physical analysis.
 - 1. Tensile and bend tests shall be performed by the mill in accordance with ASTM A615 or A706, as applicable to reinforcing type.

I. Samples: Only as required by Architect.

1.06 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301.
 - 1. Maintain one copy of each document on project site.
- B. Tests and Inspections:
 - 1. Provide Architect and Special Inspection Agency with access to fabrication plant to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection.
 - 2. A testing program is required prior to the start of construction. Testing program to be done in compliance with the CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.
 - 3. All reinforcing steel whose properties are not identifiable by mill test reports shall be tested in accordance with ASTM A615. One Series of tests for each missing report to be borne by the Contractor.
 - 4. When inspections are indicated for reinforcement placement on the Structural drawings, a special inspector shall be employed to inspect reinforcing placement per CBC Chapter 17.
 - 5. When tests are indicated for reinforcing steel on the structural drawings, the reinforcing steel used shall be tested in accordance with ASTM A615. One tensile and one bend test for each 2-1/2 tons of steel or fraction thereof, shall be made.
 - 6. Inspect shop and field welding in accordance with AWS D1.4, including checking materials, equipment, procedure, and welder qualification as well as the welds. Inspector will use non-destructive testing or any other non-destructive aid to visual inspection that Inspector deems necessary to assure the adequacy of the weld.
 - 7. Tests and inspection shall be performed by Owners testing agency except when needed to justify rejected work, in which case the cost of retests and reinspection shall be paid by the Owner and back-charged to the Contractor.
- C. Installer Qualifications:
 - 1. Reinforcing Steel: Installation shall be done only by an installation firm normally engaged in this business. All work shall be performed by qualified mechanics working under an experienced supervisor.
- D. Manufacturer Qualifications:
 - Reinforcing Steel: A firm regularly engaged in the manufacture of steel bar and welded wire fabric reinforcing.
- E. Mechanical Bar Couplers shall have a current ICC-ES or IAPMO Evaluation Report that indicates compliance with the requirements of these specifications.
- F. Steel Reinforcing Allowable Tolerance (ACI 117):
 - 1. Fabrication:
 - a. Sheared length: 1 inch.
 - b. Depth of truss bars: Plus or minus 1/2-inch.
 - c. Ties: Plus or minus 1/2-inch.
 - d. All other bends: Plus or minus 1 inch.
 - 2. Placement:
 - a. Concrete cover to form surfaces: Plus or minus 1/4-inch.
 - b. Minimum spacing between bars: Plus or minus 1/4-inch.
 - c. Crosswise of members: Spaced evenly within 2 inches of stated separation.
 - d. Lengthwise of members: Plus or minus 2 inches.
 - 3. Maximum bar movement to avoid interference with other reinforcing steel, conduits, or embedded items: 2 bar diameters.
- G. Unidentifiable Reinforcing Steel: Tested by testing agency; paid for by Contractor:

1. Test reinforcing delivered to site which cannot be properly identified by heat number and mill mark for compliance with ASTM A615 as follows:
 - a. No. 8 Bar and Smaller: One tensile test and one bend test of each size per 7-1/2 tons, or portion thereof.
 - b. No. 9 Bar and Larger: One tensile test of each size per 10 tons, or portion thereof.
- H. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 1. Welders whose work fails to pass inspection shall be requalified before performing further welding.
 2. Firm specializing in furnishing and installing reinforcement shall have a minimum of 5 years' experience on projects with requirements similar to this project and shall have sufficient production capacity.
 3. All welding shall be performed by operators who are qualified for the types of welds used. Each operator shall have been qualified within the preceding one year as prescribed by AWS.
 4. Require welders to retake the qualification test if, as determined by the Architect, there is a reasonable doubt as to the proficiency of the welder. If the welder does not requalify, they shall not perform any welding on the project.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement
 1. Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement where occur.
 2. Deliver reinforcing to Site properly bundled and tagged. Use tags that indicate bar size, lengths and marks corresponding to markings shown on shop drawings. Bundles shall be identified as to heat number and manufacturer and be accompanied by mill and analysis test reports and affidavit from the supplier stating that the material conforms to the requirements of the ASTM specification listed therein. Segregate to maintain identification after bundles are broken.
 3. Store reinforcement in a manner that will prevent excessive rusting or fouling with/ grease, oil, dirt, and other bond weakening materials.
 4. Do not use damaged, reworked, or deteriorated material.
- B. Deliver and store welding electrodes in accordance with AWS D1.4.

PART 2 PRODUCTS

2.01 STEEL REINFORCEMENT

- A. Reinforcing Steel: ASTM A615, Grade 60 (60,000 psi) deformed for all bars unless otherwise indicated.
 1. Plain billet-steel bars where indicated.
 2. Unfinished.
- B. Reinforcing Steel: ASTM A706, Grade 60 (60,000 psi) deformed low-alloy steel bars for bars to be welded.
 1. Unfinished.
- C. Reinforcing Steel: Dual grade ASTM A615/A706, Grade 60 (60,000 psi) may be used in lieu of A615 or A706, Grade 60 (60,000 psi).
 1. Unfinished.
- D. Reinforcing Steel: ASTM A706, Grade 60 (60,000 psi) for bars used in special seismic systems as indicated in drawings.
 1. Unfinished.
 2. ASTM A615 Grade 60 bars meeting the following requirements of ACI 318 may be used in lieu of A706 Grade 60 in special seismic systems.

- a. Actual yield strength based on mill tests does not exceed more than 78,000 psi.
 - b. The ratio of the actual tensile strength to the actual yield strength is at least 1.25.
 - c. Minimum fracture elongation in 8 in. shall be at least 14% for bar sizes #3 through #6, at least 12% for bar sizes #7 through #11, and at least 10% for bar sizes #14 and #18.
- E. Minimum uniform elongation shall be at least 9% for bar sizes #3 through #10, and at least 6% for bar sizes #11 through #18. reinforcing Steel: Plain or deformed bars; ASTM A1035, Grade 100 (100,000 psi), Type CL.
- F. Stirrup and Tie Steel: ASTM A615 grade 60 for all bars, unfinished.
- G. Reinforcing steel used as spiral reinforcing as noted on the drawings shall conform to ASTM A615 unless noted otherwise.
- H. Deformed Bar Anchors: AWS Type D studs manufactured in conformance with ASTM A 496 with a minimum tensile strength of 80,000 PSI. ASTM A 615 reinforcing bars may not be substituted for deformed bar anchors. Reinforcement shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Service Report submitted for Engineer review. The following are acceptable products, provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
 - 1. Nelson Stud Welding, Inc.; Nelson D2L Deformed Bar Anchor Studs (ESR-2907).
 - 2. Tru-Weld Division, TFP Corporation; Deformed Bar Anchors (ESR-2823).
- I. Epoxy-Coated Reinforcing Steel: Provide epoxy coated reinforcing bars at the locations indicated on the drawings. Epoxy coated reinforcing bars shall conform to ASTM A 775. Bars that are to be epoxy coated shall conform to the type of steel required for the given situation as noted on the drawings.
- J. Steel Dowels: Same grade as bars to which dowels are connected.
- K. Steel Welded Wire Reinforcement (WWR): Plain type; ASTM A1064 with a yield strength of 65,000 psi. Provide flat sheets only. Spacing and size of wire as indicated in drawings.
- L. Reinforcement Accessories:
 - 1. Tie Wire: FS-QQ-W-461, annealed, minimum 16-gauge, 0.0508 inch.
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
 - a. Wire support: CRSI class 2.
 - b. Do not use wood, brick, or other objectionable materials.
 - c. Do not use galvanized supports.
 - d. Supports placed against ground: Pre-cast concrete blocks not less than 4 inches square with embedded wire.
 - 3. Provide stainless steel components for placement within 1-1/2 inches of weathering surfaces.
- M. Welding Electrodes: AWS D1.4, low hydrogen, E70XX series.
- N. Headed Steel Stud Punching Shear Reinforcement: Punching shear reinforcement using headed studs welded to flat bars shall be manufactured in conformance with ASTM A 1044 and approved by the ICC Evaluation Service, Inc. as expressed in an ICC Evaluation Report for use as punching shear reinforcement for slabs and footings designed in accordance with ACI 421.1.
 - 1. Studs
 - a. Nelson Stud Welding Inc.; Nelson Punching Shear Resistor Studs (ESR-1170).
 - b. Tru-Weld Division, TFP Corporation; Tru-Weld Punching Shear Resistor Studs (ESR-2822).
 - 2. Assemblies
 - a. Dayton Superior Corporation; Dayton Shear Resistance System (ESR-2696).
 - b. Decon, Inc.; Decon Studrails (ESR 2494).
 - c. Dywidag Systems International USA, Inc.; Dywidag Shear System (ESR-2534).

- d. Jobsite Stud Welding, Inc.; Jobsite Stud Welding Punching Shear Resistor Shear Rail Assemblies (ESR-3264).
 - e. Simpson Strong-Tie Company, Inc.; Simpson Strong-Tie Punching Shear Resistor Rail (ESR-2992).
 - f. SRL Industries LTD.; SRL Punching Shear Resistor Shear Rails (ESR-2938).
- O. Hooked Anchorage Replacement: Reinforcing bar terminations shall be manufactured out of ASTM A 576, ASTM A 615, or A 706 material and shall develop the full tensile strength of the bar when installed at the manufacturer's recommended depth.
- 1. The anchorage shall be approved by the ICC Evaluation Service Inc. as expressed in an ICC Evaluation Service Report which shall be submitted for review.
 - 2. The following are acceptable products (for use only with grade 60 bars), provided that their Evaluation Service Reports are still valid at the time of intended use on the project:
 - a. Dextra Manufacturing Co., Ltd; Bartec Mechanical Anchorages for Steel Reinforcing Bars in Concrete (ESR-2166).
 - b. Headed Reinforcement Corporation; HRC 555 Headed Reinforcing Bars (ESR-2935).
 - c. Erico Products, Inc.; Lenton Terminator (ER-3967).

2.02 REINFORCING BAR SPLICING:

- A. Coupler Systems: Mechanical devices for splicing reinforcing bars; Comply with ACI 318 Chapter 25.
- 1. Mechanical splices shall conform to Type 1 or Type 2 splices. Where not specifically indicated, use type 2 splices.
 - a. Type 1 splice shall develop, in tension and compression, 1.25 times the specified yield strength of the splice bar.
 - b. Type 2 splice shall meet the requirements of Type 1 splice and, in addition, develop the full tensile strength of the splice bar.
 - c. Splices shall be approved by the ICC-Evaluation Service, Inc and shall have the Evaluation Service Report submitted for Engineer review.
 - 2. Manufacturers:
 - a. Headed Reinforcement Corporation (HRC)
 - b. nVent Lenton
 - c. Dayton Superior Corporation
 - d. Splice Sleeve North America, Inc; NMB Splice Sleeve System
 - e. Substitutions: See Division 01 - Product Requirements.
- B. Form Savers: Mechanical devices for connecting dowels and reinforcing bars at construction joints; capable of developing full steel reinforcing design strength in tension and compression.
- 1. Manufacturers:
 - a. nVent Lenton
 - b. Substitutions: See Division 01 - Product Requirements.
- C. Taper Tie Hole Plug: Mechanical device for plugging tie holes; anchors optional flush or recessed grout.
- 1. Manufacturers:
 - a. Dayton Superior Corporation
 - b. Substitutions: See Division 01 - Product Requirements.
- D. Grout: Cementitious, non-metallic, non-shrink grout for use with manufacturer's grout sleeve reinforcing bar coupler system.
- 1. Manufacturers:
 - a. Dayton Superior Corporation
 - b. Substitutions: See Division 01 - Product Requirements.

2.03 FIBER REINFORCEMENT

- A. See specification section 03 30 00.

2.04 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice and to meet requirements of Drawings.
- B. Fabricate reinforcement in accordance with the requirements of ACI 315R where specific details are not shown or where Drawings and Specifications are not more demanding.
- C. Steel reinforcement shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the Drawings shall not be used. Heating of bars for bending will not be permitted.
- D. Reinforcing shall not be field bent or straightened without structural engineer's review.
- E. Provide offsets in rebar (1:6 maximum) where required to maintain clearances.
- F. Fusion welding of preassembled cages shall be permitted only under the following conditions:
 - 1. Fusion welding of holding wires to ties, stirrups, and hoops in beams, columns, and grade beams to preassemble reinforcing cages is permissible. The holding wire area shall not exceed 5% of the beam, column, or grade beam cross sectional longitudinal steel area. Fusion welding is not allowed to longitudinal reinforcing steel in any beam, column, or grade beam.
 - 2. Fusion welding of holding wires to the ends of the reinforcing steel placed in mats (spread footings, slab reinforcement, etc.) is permitted provided the fusion weld occurs within 6 bar diameters of the free end of the bar (e.g. no allowed at the end of coupled, T-headed, or weld splice bars).
 - 3. Fusion welding of holding wires shall not occur on a bent portion of a reinforcing bar. Bars may not be bent where a fusion weld occurs.
 - 4. Holding wires shall conform to ASTM A496.
 - 5. All reinforcing steel to be welded shall comply with ASTM A706.
 - 6. Submit complete structural plans indicating which members will use fusion welding process for assembly. Provide complete structural details indicating the size of stirrups and holding wires and welding requirements. Submit a complete shop welding program which includes the following:
 - a. Type of the specific fusion welding machine
 - 7. Periodic inspection protocol of the in-plant welding. This information shall be submitted to the Structural Engineer (SEOR) and the Owner's Testing Agency for approval. Fusion welding and fabrication is not permitted until approved by the SEOR.

PART 3 EXECUTION

3.01 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from the required position. All reinforcement shall be accurately set in place, lapped, spliced, spaced rigidly and securely held in place and tied with specified wire at all splices and crossing points. All wire tie ends shall point away from the form. Carefully locate all dowel steel to align with wall and column steel.
 - 1. Comply with CRSI recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports and as herein specified.
 - 2. Bars shall be in long lengths with laps and splices as shown. Offset laps in adjacent bars. Place steel with clearances and cover as shown. Bar laps shall be as indicated on the Drawings. Tie all laps and intersections with the specified wire.
 - 3. For horizontal reinforcement, maintain clear space between parallel bars not less than 1 times nominal reinforcement diameter, but in no case shall clear space be less than 4/3 times maximum size concrete aggregate.
 - 4. For vertical reinforcement, maintain clear space between parallel bars not less than 1-1/2 times nominal reinforcement diameter, but in no case shall clear space be less than 4/3 times maximum size concrete aggregate.

5. Reinforcing dowels for slabs shall be placed as detailed. Sleeves may be used if reviewed by the Structural Engineer before installation. Install dowel through all construction and expansion joints for all slabs on grade. Support slab-on-grade joint dowel bars independently of support for slab reinforcement on soil supported slab bolsters or specially manufactured cradles such that dowel bar remains parallel to slab surface and at right angles to joint during concreting operations. Lightly coat the exposed end of the dowel with a paraffin-base lubricant, asphalt emulsion, form oil, or grease or use a dowel bar sleeve.
 6. Provide and place additional reinforcing steel at all sleeves and openings in beams, slabs, and walls as specified on the drawings. Where sleeves or openings not shown on the drawings interrupt the reinforcement, consult with Engineer for instructions for placing and splicing of bars. Provide the required additional reinforcing steel at no additional cost to the Owner.
 7. Epoxy-Coated Reinforcement: Use epoxy-coated steel tie wires to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963.
 8. Do not bend reinforcement that is embedded partially in concrete except in locations noted on the drawings or approved by the Engineer.
- B. Reinforcement in Composite Metal Deck Slab
1. Composite steel deck slabs shall be reinforced as indicated on the drawings.
 2. Extra Reinforcement over Girders: Provide additional reinforcing steel over interior girders as shown on the drawings.
 3. Placement of Slab Reinforcement: Provide bolsters, high chairs, and/or additional reinforcing as shown in details on the drawings to support the reinforcing with the clear cover shown on the drawings.
- C. Reinforcement in Topping Slabs
1. Provide welded smooth wire reinforcement minimum 6 x 6 W1.4 x W1.4 in all topping slabs unless specified otherwise on the drawings.
- D. Bar Supports: Support and securely fasten bars with chairs, spacers and ties to prevent displacement by construction loads or placement of concrete beyond the tolerances specified. Conform to CRSI as a minimum standard.
- E. Steel Adjustment:
1. Move within ACI 117 specified allowable tolerances to avoid interference with other reinforcing steel, conduits, or embedded items.
 2. Do not move bars beyond allowable without concurrence of Structural Engineer.
 3. Do not heat, bend, or cut bars without concurrence of Structural Engineer.
 4. Reinforcement shall not be bent after being embedded in hardened concrete.
- F. Splices:
1. Provide splices as indicated on the drawings. Splice reinforcing bars only at locations shown on the structural drawings and approved shop drawings. Unauthorized or unscheduled splices not approved by the Engineer in writing will not be accepted.
 2. All lap splices in reinforcing steel shall be contact lap splices unless detailed otherwise on the drawings.
 3. Maintain proper cover and spacing between reinforcing bars at splices.
 4. Lap unscheduled reinforcing bars not otherwise specified with a Class B lap splice.
 5. Lap Splices: Tie securely with wire to prevent displacement of splices during placement of concrete.
 6. Mechanical Splice Devices: Install in accordance with manufacturer's written instructions. Obtain Structural Engineer's review before using. The manufacturer of mechanical splice shall be present for first day's installation.
 7. Do not splice bars except at locations shown without concurrence of Structural Engineer.
 - a. Where splices in addition to those indicated are required, indicate location on shop drawings clearly and highlight "for Engineer's approval".

- G. Repair of Epoxy-Coated Reinforcing: Repair cut and damaged epoxy coatings on fabricated reinforcing before delivery with epoxy repair coating according to ASTM D 3963.
- H. Do not displace or damage vapor barrier.
- I. Accommodate placement of formed openings.
- J. Refer to Structural Drawings for concrete cover requirements over reinforcement.
- K. Concrete shown without reinforcing shall be reinforced as similar parts shown with reinforcing except where concrete is specifically noted to be unreinforced.
- L. Examine surfaces and conditions receiving or affecting the work. Do not proceed until unsuitable conditions have been corrected.
- M. Welding:
 - 1. Welding is only permitted where specifically detailed on Drawings or approved by Engineer.
 - 2. Employ shielding metal-arc method and meet requirements of AWS D1.4.
 - 3. Welding is not permitted on bars where the carbon equivalent is unknown or is determined to exceed 0.55.
 - 4. Welding shall not be done within two bar diameters of any bent portion of a bar which has been bent cold.
 - 5. Tack welding of reinforcement is not permitted, unless specifically requested by the Contractor and approved by the Structural Engineer of Record.
 - 6. Welding of crossing bars is not permitted.
- N. Welded Wire Fabric: Install in long lengths, lapping 24 inches at end splices and one mesh at side splices. Offset laps in adjacent widths. Place fabric in approximately the middle of the slab thickness unless shown otherwise on the Drawings by dimension. Wire tie lap joints at 12-inch centers. Use concrete blocks to support mesh in proper position.
- O. Reinforcement shall be free of mud, oil or other materials that may reduce bond at the time concrete is placed. Reinforcement with tightly adhered rust or mill scale will be accepted without cleaning provided that rusting has not reduced dimensions and weights below applicable standards. Remove loose rust.
- P. Protection against rust:
 - 1. Where there is danger of rust staining adjacent surfaces, wrap reinforcement with impervious tape or otherwise prevent rust staining.
 - 2. Remove protective materials and clean reinforcement as required before proceeding with concrete placement.
- Q. Refer to notes on Drawings for additional reinforcement requirements.
- R. Refer to Mechanical and Electrical Drawings for formed concrete requiring reinforcing steel. All such steel shall be included under the work of this Section.

3.02 FIELD QUALITY CONTROL

- A. An independent testing agency, as specified in Division 01 - Quality Requirements, will inspect installed reinforcement for compliance with contract documents before concrete placement.
- B. Reinforcing Steel
 - 1. Notify the testing agency and the Architect at least 48 hours before concrete is to be poured or reinforcing is covered up.
 - 2. Before any concrete is poured on any portion of the building, the reinforcing steel and form dimensions will be inspected by the Testing Agency. Any errors or discrepancies shall be corrected before concrete is placed.
 - 3. A testing program is required prior to the start of construction. Testing program to be done in compliance with the CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in the final testing program.

4. All reinforcing steel whose properties are not identifiable by mill test reports shall be tested in accordance with ASTM A615. One Series of tests for each missing report shall be made and costs shall be borne by the Contractor.
5. When tests are indicated for reinforcing steel on the structural drawings, the reinforcing steel used shall be tested in accordance with ASTM A615. One tensile and one bend test for each 2-1/2 tons of steel or fraction thereof, shall be made.
6. In addition to other required inspections, the following are subject to Special Inspection as per the CBC:
 - a. Placement of Reinforcing Steel
 - b. Welding of Reinforcing Steel
7. A special inspector from the Testing Agency shall be present during all field bending of reinforcement.
8. Installation of deformed bar anchors to be tested in accordance with Section 7.1 of AWS D1.1.
9. Welding of Reinforcement: There shall be continuous inspection during all welding of reinforcement. All butt welds are to be inspected using radiographic testing. At the Owners option recognized non-destructive tests such as resistance, Magnetic Particle Examination, and Liquid Penetrant Inspection may be used to inspect the welds. Inspect shop and field welding in accordance with AWS D1.4, including checking materials, equipment, procedure, and welder qualification as well as the welds. The inspector will use non-destructive testing or any other aid to visual inspection that he deems necessary to assure the adequacy of the weld.
10. Comply with ICC-ES or IAPMO approvals with respect to special inspection required during installation.
11. Testing and inspection of mechanical splices and reinforcing couplers to conform to manufacturer's recommendations and ICC-ES or IAPMO approval.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Cast-in-place concrete building elements.
- B. Concrete for composite floor construction.
- C. Elevated concrete slabs.
- D. Slabs on grade.
- E. Concrete foundations.
- F. Grouting of steel base plates.
- G. Joint devices associated with concrete work.
- H. Concrete curing.

1.03 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 03 20 00 - Concrete Reinforcing.
- C. Section 05 12 00 – Structural Steel

1.04 REFERENCE STANDARDS

- A. Utilize the edition of the listed document as identified in the “Design Criteria Notes” in the structural drawings. If not listed in the “Design Criteria Notes”, use the edition adopted or referenced by the listed governing building code or material standard. If no specific edition is adopted, use the latest edition.
 - 1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
 - 2. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - 3. ACI 211.2 – Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
 - 4. ACI 301 - Specifications for Concrete Construction.
 - 5. ACI 302.1R - Guide to Concrete Floor and Slab Construction.
 - 6. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 - 7. ACI 305R – Guide to Hot Weather Concreting.
 - 8. ACI 306R – Guide to Cold Weather Concreting.
 - 9. ACI 308R - Guide to External Curing of Concrete.
 - 10. ACI 318 - Building Code Requirements for Structural Concrete.
 - 11. ACI 360R – Guide to Design of Slabs-On-Ground.
 - 12. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - 13. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 14. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 15. ASTM C42 – Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - 16. ASTM C94 - Standard Specification for Ready-Mixed Concrete.

17. ASTM C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
18. ASTM C143 – Standard Test Method for Slump of Hydraulic Cement Concrete.
19. ASTM C150 - Standard Specification for Portland Cement.
20. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete by the Volumetric Method.
21. ASTM C192 – Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
22. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
23. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
24. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
25. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
26. ASTM C567 – Standard Test Method for Determining Density of Structural Lightweight Concrete.
27. ASTM C618 – Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
28. ASTM C685 – Standard Specification for Volumetric Batching and Continuous Mixing.
29. ASTM C989 – Standard Specification for Slag Cement for Use in Concrete and Mortars.
30. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete.
31. ASTM C1157 – Standard Performance Specification for Hydraulic-Cement.
32. ASTM C1582 - Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete.
33. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.

1.05 SUBMITTALS

- A. See Division 01 - Administrative Requirements for submittal procedures.
- B. General:
 1. Review of submittals is of a general nature only, and the responsibility for conformance with intent of drawings shall remain with the Contractor. Review does not imply or state that the fabricator has correctly interpreted the construction documents.
 2. All submissions shall be in accordance with the submission schedule developed and agreed between the Architect and Contractor at the commencement of the project. Submission shall include dates of order and delivery of materials to the shop and the site.
 3. Shop drawing schedule shall allow adequate time for reviews. Reinforcing steel shall not be fabricated or placed before the shop drawings have been reviewed by the Architect and returned.
- C. Concrete Design Mixtures: Each concrete mix design to be used on the project shall be reviewed and approved by the Testing Agency prior to concrete being delivered to site. Owner's Testing Agency shall review all mix designs prior to submittal. Submit proposed mix designs for each class of concrete listed on drawings. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 1. For each concrete mixture, the following information shall be included: where the mix is to be used, all materials and admixtures including their source and proportions in the mix; Water content, water-to-cement ratio, slump, and aggregate grading; whether the mixture is appropriate for pumping; and total chloride content.
 2. Indicate compressive strength and method used to determine strength. The compressive strength of the concrete shall be proportioned per ACI. Include all calculations and tests required by ACI 318 Chapter 5. Laboratory test data must be submitted along with calculations that show each mix design meets the strength requirement. Mix design number must match the mix design number shown on the test data. Include all test

- results or past history back up data specific as part of the submittal. Test results within the past two years shall be used to indicate performance in accordance with past history.
3. Indicate amounts of mixing water to be withheld for later addition at Project site.
- D. Transit-mix delivery slips.
1. Keep record at the Site showing time and place of each pour of concrete, together with transit mix delivery slip certifying contents of the pour per ASTM C94. Include the time water was added to dry mix.
 2. Make the record available for inspection at the Site and to the Architect for his review upon request.
 3. Upon completion of this portion of the Work, deliver the record and the delivery slips to the Architect.
- E. Reinforcement: Comply with submittal requirements in Section 03 20 00.
- F. Formwork and Shoring: Comply with submittal requirements in Section 03 10 00.
- G. Layout drawings for construction, control, and expansion joints for Engineer and Architect review.
- H. Certificates of Compliance from manufacturer or supplier:
1. Material Test Reports:
 - a. Cement Certificates per CBC Chapter 17.
 - 1) Cement without a certificate shall not be used.
 - b. Aggregates: Material test reports for the following, from a qualified testing agency, indicating compliance with requirements:
 - 1) Light weight aggregate (per ASTM C330).
 - 2) Normal weight aggregate (per ASTM C33). Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity. Include evaluation of reactivity.
 2. Product Test Reports and Certificates: Include ICC-ES or IAPMO reports where available. Provide for each of the following, signed by manufacturers.:
 - a. Cementitious materials, per ASTM C150, ASTM C595, ASTM C618, ASTM C989, and/or ASTM C1240, as applicable.
 - b. Admixtures. Where more than one admixture is used, include certification that admixtures are compatible. Per ASTM C494 for each type used; include chloride ion content.
 - c. Fiber reinforcement.
 - d. Curing compounds. Also include data on method of removal in the event of incompatibility with floor covering adhesives.
 - e. Floor and slab treatments.
 - f. Non-shrink grout, per ASTM C1107 Grade B.
 - g. Bonding agents.
 - h. Vapor retarders.
 - i. Semirigid joint filler and joint-filler strips
 - j. Waterstops.
 - k. Post-installed concrete anchors.
 - l. Repair materials.
- I. Hardeners and sealers: Provide manufacturer's data.
- J. Grout samples for sacked surface textures and colors upon Architect's request only.
- K. Field quality-control test and inspection reports.
- L. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

1.06 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318 and applicable standards listed in the Reference Standards section.
 - 1. Maintain one copy of ACI 301 and ACI 318 on site.
- B. Follow recommendations of ACI 305R when concreting during hot weather.
- C. Follow recommendations of ACI 306R when concreting during cold weather.
- D. For slabs required to include moisture vapor reducing admixture (MVRA), do not proceed with placement unless manufacturer's representative is present for every day of placement except when waived by owner.
- E. For slabs indicated to receive membrane-forming, moisture emission-reducing, curing and sealing compound, do not proceed with application unless manufacturer's representative is present for every day of placement except when waived by owner.
- F. Installer Qualifications:
 - 1. Concrete: A qualified installer who employs Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- G. Manufacturer Qualifications:
 - 1. Concrete: A firm experienced in manufacturing ready-mixed concrete products that complies with ASTM C94 requirements for production facilities and equipment.
 - a. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- H. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated, as documented according to ASTM E548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. The Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
 - 3. Shop and field testing and inspection of steelwork shall be performed by an inspector currently certified as an AWS Certified Welding Inspector.
- I. Testing Agency: Shall be selected and paid for by the Owner, unless otherwise specified; re-testing paid for by the Contractor.
- J. Contractor's Quality Control Plan: Quality Control includes the functions performed by the Contractor to ensure that the material and workmanship of concrete construction meets the project specifications and applicable standards. The Contractor shall submit a Quality Control Plan that addresses all inspection issues, including testing and inspection per ACI. The verification testing and inspection carried out by the Testing Agency does not relieve the contractor of the responsibility for conducting their own quality control/inspection program to ensure the requirements of the Contract Documents have been met. The Contractor's Quality Control Plan will be reviewed by the Testing Agency.
- K. Quality Control Inspector Qualifications: Along with Quality Control Plan, Contractor shall submit written qualifications for all inspectors to be assigned Quality Control functions for concrete work.
- L. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- M. Mechanical Bar Couplers shall have a current ICC-ES or IAPMO Evaluation Report that indicates compliance with the requirements of these specifications.

- N. Steel Reinforcing Allowable Tolerances: Comply with ACI 117 and requirements in Section 03 20 00.
1. Refer to Section 03 20 00.
- O. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to test concrete mixtures. When mixes are proportioned by trial batch method, engage a Laboratory conforming to ASTM E329 and under direction of a Professional Engineer licensed in the State in which the Project is located.
- P. Formwork:
1. See Section 03 10 00.
- Q. Prefabrication and Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.
- R. Tests and Inspections:
1. Provide special inspections and testing as described in the "Statement of Structural Special Inspections and Testing" within the structural drawings, and/or TIO form, and as required by this section.
 2. A testing program is required prior to start of construction. Testing program to be done in Compliance with the CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.
 3. The following tests shall be made by a recognized testing laboratory selected by the Owner and approved by the governing agency. All tests shall be in accordance with the previously mentioned standards and ACI 318 Section 26.12. A complete record of all tests and inspections shall be kept per CBC Section 1704.5.
 - a. Compressive Strength: Make and cure in accordance with ASTM C-31. Test in accordance with ASTM C-39 and ACI 318 Section 26.12. Standard cure testing shall be utilized. Supplementary field cure testing shall occur where required by SEOR and/or AHJ.
 - 1) A record shall be made of time and of locations of concrete from which samples were taken.
 - 2) A minimum of five identical cylinders shall be taken from each pour of 150 cubic yards or 5000 square feet or part thereof, being placed each day per ACI 318 Section 26.12.2. One cylinder shall be tested at age 7 days, and a minimum of three at age 28 days unless otherwise specified. Preserve a minimum of one remaining cylinder for future use.
 - b. Drying Shrinkage: (applies always for lightweight concrete; also applies for other mixes if specified as such in drawings or specifications).
 - 1) A record shall be made of time cylinders and of locations of concrete from which samples were taken.

- 2) Three identical 4" x 4" x 11" specimens shall be made from same concrete as used in structure. Percent of shrinkage shall be reported at 21 days after 7 day moist curing period. Average results of 3 specimens shall be used as the accepted value. The value for laboratory cast specimens shall not exceed .075%. If field test specimens are used in lieu of laboratory specimens, a tolerance of +33% may be used.
- 3) Test specimens in accordance with ASTM C157.
- c. Concrete consistency (slump) shall be tested in accordance with ASTM C143.
4. Provide full time inspection per CBC Section 1705.3 during the taking of test specimens and during the placing of all concrete and embedded steel.
5. See Section 03 20 00 for reinforcing steel tests and inspections.
6. Provide concrete batch plant inspections per ASTM C685.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Steel Reinforcement:
 1. See Section 03 20 00.
- B. Deliver and store welding electrodes in accordance with AWS D1.4.
- C. Formwork: Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.
- D. Concrete Materials:
 1. Protect cement from moisture and rotate stock to ensure fresh materials.
 2. Protect aggregates as necessary to maintain saturated condition when batched.
 3. Storage methods should comply with ACI 301 4.1.4.
- E. Contractor to coordinate with owner and/or testing laboratory to provide facilities for job curing of test cylinders and transporting to Testing Laboratory.
- F. Comply with all local building and fire codes for fire safety during construction.

PART 2 PRODUCTS

2.01 CONCRETE MIXES

- A. Concrete mixes shall be as stated in the Structural Documents with strength, maximum aggregate size, weight, maximum water to cement ratio, and location of usage.
 1. Cement content as required by mix design (ACI 318 Section 26.4.3).
 2. Admixtures: Water Reducing
 3. Weight
 - a. Normal Weight Concrete (NWC): 150 lbs. per cubic foot maximum
 - b. Lightweight Concrete (LWC): 113 ± 3 lbs. per cubic foot. (Equilibrium Density per ASTM C567)
 4. Air Entrainment
 - a. As required for UL rating (4%-7% for LWC)
 - b. As required for Durability Requirements per ACI 318 Chapter 19
 - c. As required in Construction Documents

2.02 FORMWORK

- A. Comply with requirements of Section 03 10 00.

2.03 REINFORCEMENT MATERIALS

- A. Comply with requirements of Section 03 20 00.

2.04 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C150, Type II, II/V, Type V, or ASTM C595 Type 1L. One brand of cement shall be used throughout to maintain uniform color for all exposed concrete.
 2. Supplement Portland Cement with the following Supplementary Cementitious Materials (SCM):
 - a. Fly Ash Pozzolan: ASTM C618, F as required.
 - b. Blast-Furnace Slag: ASTM C989-10
 - c. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.
 3. The SCM producer shall have a minimum of 5 years' experience in the production of acceptable SCM and shall practice an effective quality control program to guard against contamination of the SCM.
 4. Cementitious material used shall have at least 2 years of use with proposed aggregates without detrimental reaction.
 5. Alkali content shall not exceed 0.6% when tested in accordance with ASTM C114.
 6. The temperature of cement delivered to the plant shall not exceed 150 degrees F.
- B. Normal-Weight Aggregates: ASTM C33, fine and coarse aggregate, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. Aggregate shall be crushed granite or Perkins type.
1. Select coarse-aggregate size from three options in subparagraph below; add gradation requirements if preferred. Aggregate size limits relate to spacing of steel reinforcement, depth of slab, or thickness of concrete member.
 2. Coarse Aggregate:
 - a. Aggregate shall contain no thin or elongated pieces. Any piece having a major dimension more than 2-1/2 times the average thickness shall be considered thin or elongated.
 - b. If shrinkage-controlled concrete, Coarse Aggregate shall be crushed limestone, granite, or accepted equal.
 - c. The maximum size used in a particular location shall be consistent with the form and dimensions of the section being placed, with the location and spacing of the reinforcing steel and with the method of vibration. The aggregate sizes shall be such as will produce dense, uniform concrete, free of rock pockets, honeycombs, or other irregularities.
 - d. Combined aggregate gradation for slabs and other designated concrete shall be 8% to 18% for large top size aggregates (1-1/2-inch) or 8% - 22% for smaller top size aggregates (1-inch or 3/4-inch) retained on each sieve below the top size and above the No. 100.
 3. Fine Aggregate: Uniformly graded, clean sand, free from excessive fines, organic materials or other deleterious materials. Free of materials with deleterious reactivity to alkali in cement.
- C. Lightweight Aggregate: ASTM C330, to be specified between 1-inch and 3/8-inch nominal maximum aggregate size.
1. Lightweight cellular and granular inorganic materials, free from oil, organic matter, or other deleterious substances.
 2. Uniformly graded from 1/4-inch to maximum size. The combined grading shall be such that the percentage of weight of the combined aggregates shall fall within the limits established by ASTM C330.
 3. Dry weight of lightweight concrete shall be as specified above. Comply with ASTM C567 for oven dry density testing if specifically required by code or jurisdiction. Contractor to verify density of concrete meets the requirements of the UL rating.
 4. Lightweight Aggregates Rotary Kiln Produced: Expanded shale slate, clay or slag aggregate, the maximum size used in a particular location shall be consistent with the form and dimensions of the section being placed, with the location and spacing of the reinforcing

steel and with the method of vibration. The aggregate sizes shall be such as will produce dense, uniform concrete, free of rock pockets, honeycombs, or other irregularities.

- D. Water: Clean and free from injurious amounts of oil, acids, alkali, organic matter and other deleterious substances; suitable for domestic consumption.
- E. Use of shotcrete except where specifically permitted in contract documents is prohibited.
- F. Use of Returned Plastic Concrete (RPC) or Returned Fresh Concrete is prohibited.

2.05

ADMIXTURES

- A. General: Where more than one is used, admixtures shall be compatible. Use of admixtures shall be consistent throughout Work.
 - 1. Use of alternate admixtures may only be used with the written acceptance of the Architect. See Substitutions Division 01 – Product Requirements.
 - 2. Admixtures to be in accordance with ACI 318 Section 26.4.1.4.
 - 3. Prohibited Admixtures: Admixtures containing more than 0.05 percent chloride ions, fluorides, sulphites, thiocyanates, and/or nitrates are not permitted. Do not use admixtures that will negatively impact the visual finish of concrete exposed to view. Calcium chloride is not permitted.
- B. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other admixtures.
 - 1. Available Products:
 - a. Grace Construction Materials; Darex AEA or Daravair.
 - b. Master Builders, Inc.; MB-VR or Micro Air.
 - c. Euclid Chemical Company (The); Air Mix.
- C. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing (Plasticizing) Admixture: ASTM C494, Type A for use in cool weather. Available Products:
 - a. Grace Construction Products, W. R. Grace & Co.; "WRDA with Hycol".
 - b. Master Builders, Inc.; "Pozzolith 220N".
 - c. Euclid Chemical Company (The); "WR-75, WR-91 or Eucon MR".
 - 2. Retarding Admixture: ASTM C494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C494, Type D for use in hot weather. Available Products:
 - a. Sika Corporation; "Sikament 30".
 - b. Euclid Chemical Company (The); "Eucon Retarder-75".
 - 4. Mid-Range, Water-Reducers ASTM C494. Available Products:
 - 1) Master Builders "Polyheed."
 - 5. Plasticizing and Retarding Admixture: ASTM C1017, Type II.
 - 6. Non-Chloride, Non-Corrosive Accelerating Admixture: ASTM C494, Type C or E. Manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method. Available Products:
 - a. Euclid Chemical Company (The); "Accelguard 80, 90, or NCA".
 - 7. Shrinkage Reducing Admixture: ASTM C494, Type S.
 - a. Euclid Chemical Company; Eucon SRA Floor; Eucon SRA-XT.
 - b. GCP Applied Technologies; Eclipse Floor 200; Eclipse 4500.
 - 8. Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties.
 - a. Admixture Composition: Crystalline, functioning by growth of crystals in capillary pores.

- b. Admixture Composition: Hydrophobic polymer waterproofing and corrosion inhibitor, functioning by closing concrete pores and chemical bonding.
 - c. Permeability of Cured Concrete: No measurable leakage when tested in accordance with COE CRD-C 48 at 200 psi (1.38 MPa); provide test reports.
 - d. Potable Water Contact Approval: National Science Foundation (NSF) certification for use on structures holding potable water, based on testing in accordance with NSF 61 and NSF 372.
 - e. Available Products:
 - 2) Euclid Chemical Company; Eucon Vandex AM-10.
 - 3) W. R. Meadows, Inc; ADI-CON CW Plus.
 - 4) Xypex Chemical Corporation; XYPEX Admix C-500.
- D. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494, Type C.
- 1. Available Products:
 - a. Euclid Chemical Company (The); Eucon CIA.
 - b. Grace Construction Products, W. R. Grace & Co.; DCI.
 - c. Master Builders, Inc.; Rheocrete CNI.
 - d. Sika Corporation; Sika CNI.
- E. Color Pigment: ASTM C979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
- 1. Color: As selected by Architect from manufacturer's full range.
 - 2. Concentration: Base dosage rates on weight of Portland cement, fly ash, silica fume, and other cementitious materials but not aggregate or sand.

2.06 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder:
- 1. Sheet Material: ASTM E 1745, Class A, not less than 15 mils thickness. Suitable for installation in contact with soil or granular fill under concrete slabs. Single-ply polyethylene is prohibited. Include manufacturer's recommended adhesive or pressure-sensitive tape. Plastic Vapor Retarder shall have a water-vapor transmission rate (WVTR) no greater than .008 perms (grain/h xft² in x Hg) when tested in accordance with ASTM E96. Include manufacturer's recommended tape with water vapor transmission rate no greater than 0.3 perms when tested in accordance with ASTM E96. Tape shall be: a minimum of 6-mils thick, a minimum of 3 ¾ inches wide, manufactured from high density polyethylene, and have pressure sensitive adhesive. Include manufacturer's recommended vapor resistant mastic.
 - a. Sheet Products:
 - 1) Alumiseal Corporation; Zero Perm Vapor Barrier.
 - 2) Henry Company (Fortifiber); Moistop Ultra 15.
 - 3) Raven Industries Inc.; Vapor Block 15.
 - 4) Reef Industries, Inc.; Griffolyn Type-65G or 105.
 - 5) W.R. Meadows, Inc.; PERMINATOR Class A - 15 mils.
 - 6) STEGO Industries LLC; Stego Wrap Vapor Barrier.
 - 7) Substitutions: See Section 01 60 00 - Product Requirements.
 - b. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
 - 1) Vapor Retarder Tape:
 - (a) Water Vapor Transmission Rate: ASTM E 96, 0.3 perms or lower
 - (b) Minimum 6-mils thick
 - (c) Minimum 3 ¾ inches wide
 - (d) Manufactured from High Density Polyethylene
 - (e) Pressure Sensitive Adhesive

- B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents. Acceptance by Architect required before using.
1. Grout: Comply with ASTM C1107.
 2. Height Change, Plastic State; when tested in accordance with ASTM C827:
 - a. Maximum: Plus 4 percent.
 - b. Minimum: Plus 1 percent.
 3. When placed at a flowable consistency there shall be at least 95% bearing under an 18 inches x 36 inches base plate.
 4. Minimum Compressive Strength at 48 Hours: 3,000 pounds per square inch.
 5. Minimum Compressive Strength at 28 Days, ASTM C109: 7,000 pounds per square inch
 6. Flowable Products:
 - a. Euclid Chemical Company; Hi-Flow Grout.
 - b. W. R. Meadows, Inc; 588-10K; 1428 HP.
 - c. BASF Construction Products; Masterflow 713 or 928.
 - d. Sika Corporation; Sika Grout 328.
 - e. SpecChem; SC Precision Grout
 - f. Metallic grout equivalent to Master Builders "Embeco" may be used only where covered by earth, concrete, or masonry.
 - g. Substitutions: See Division 01 - Product Requirements.
 7. Low-Slump, Dry Pack Products:
 - a. Dry Pack products may only be used where approved by Architect or otherwise indicated in Drawings.
 - 1) Euclid Chemical Company; DRY PACK GROUT.
 - 2) Five Star Products, Inc; Five Star Grout.
 - 3) L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; Duragrout.
 - 4) SpecChem, LLC; SC Multipurpose Grout.
 - 5) W. R. Meadows, Inc; PAC-IT.
 - 6) Substitutions: See Division 01 - Product Requirements.
- C. Non-Shrink Epoxy Grout: For anchor reinforcing steel or threaded rods in concrete. Moisture-insensitive, two-part; consisting of epoxy resin, non-metallic aggregate, and activator.
1. Composition: High solids content material exhibiting positive expansion when tested in accordance with ASTM C827.
 - a. Maximum Height Change: Plus 4 percent.
 - b. Minimum Height Change: Plus 1 percent.
 2. Minimum Compressive Strength at 7 days, ASTM C579: 12,000 pounds per square inch (82.7 MPa).
 3. Products:
 - a. BASF Construction Products; Masterflow MP
 - b. Sika Corporation; Sikadur 32 Hi-Mod
 - c. Euclid Chemical Company; Epoxy 452 or E3G.
 - d. Five Star Products, Inc; Five Star DP Epoxy Grout.
 - e. SpecChem, LLC; SpecPoxy Grout.
 - f. Substitutions: See Division 01 - Product Requirements.
- D. Floor Leveling and Fill Materials
1. Epoxy Concrete Mortar (where areas to fill are less than ¼-inch thick): Floor leveling, non-shrink trowel applied epoxy concrete mortar.
 2. Concrete Mortar (where areas to fill are greater than ¼-inch thick): Floor leveling, patching and repair, non-shrink trowel applied concrete mortar.
 3. Cementitious Floor Leveling Material: Shall be self-leveling or trowelable with a minimum 28 day compressive strength of 3000 psi in accordance with ASTM C-109.
 - a. The Quikrete Companies; Quikrete No. 1249.

- b. Ardex; V-1200.
- c. Mapei; "UltraFlex".
- d. Substitutions: See Division 01 - Product Requirements.

2.07 BONDING AND JOINTING PRODUCTS

- A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059, Type II acrylic emulsion or styrene butadiene.
 - a. Euclid Chemical Company; AKKRO-7T; Wuco-Weld.
 - b. W. R. Meadows, Inc; ACRY-LOK.
 - c. Sonneborn; Sonobond.
 - d. Larsen Products; Weld-Crete.
 - e. Substitutions: See Division 01 - Product Requirements.
- B. Epoxy Bonding System:
 - 1. Complying with ASTM C881 and of Type required for specific application. Two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - a. Types I and II, non-load bearing or IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - 1) CTS Cement Manufacturing Corporation; Fast Anchoring and Repair Adhesive.
 - 2) Euclid Chemical Company; DURAL FAST SET LV.
 - 3) Mapei Corporation; Planibond AE, Planibond 3C.
 - 4) Substitutions: See Division 01 - Product Requirements.
- C. Waterproofing Admixture Slurry: Slurry coat of Portland cement, sand, and crystalline waterproofing additive, mixed with water in proportions recommended by manufacturer to achieve waterproofing at cold joints in concrete.
 - 1. Products:
 - a. W. R. Meadows, Inc; ADI-CON CW Plus.
 - b. Xypex Chemical Corporation; XYPEX Concentrate.
 - c. Substitutions: See Division 01 - Product Requirements.
- D. Waterstops:
 - 1. Rubber, complying with COE CRD-C 513.
 - 2. PVC, complying with COE CRD-C 572.
 - 3. Bentonite and butyl rubber, complying with NSF 61 and NSF 372.
 - 4. Synthetic rubber; swells to 1000 percent of original size in clean water.
 - 5. Configuration: As indicated on drawings.
 - 6. Size: As indicated on drawings.
 - 7. Products:
 - a. Penetron; Penebar SW-55.
 - b. CETCO, a division of Minerals Technologies Inc; WATERSTOP RX.
 - c. Kryton International, Inc; Krytonite Swelling Waterstop.
 - d. Substitutions: See Division 01 - Product Requirements.
- E. Reglets: Formed steel sheet, galvanized, not less than 26 gauge, with temporary filler to prevent concrete intrusion during placement.
- F. Slab Expansion and Isolation Joint Filler: Preformed non-extruded resilient filler.
 - 1. Material:
 - a. ASTM D1751, cellulose fiber.
 - b. ASTM D1752, sponge rubber (Type I).
 - c. ASTM D8139, semi-rigid, closed-cell polypropylene foam.
 - 2. Products:
 - a. Burke; Fiber Expansion Joint.
 - b. W.R. Meadows; Fibrated Expansion Joint Filler with Snap-Cap; Deck-O-Foam Joint Filler with pre-scored top strip.

- c. Nomaco, Inc; Nomaflex Expansion Joint Filler with Void Cap Option.
 - d. Substitutions: See Division 01 - Product Requirements.
- G. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.
- H. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches on center; ribbed steel stakes for setting.
 - 1. Provide removable plastic cap strip that forms wedge-shaped joint for sealant installation.
 - 2. Height: To suit slab thickness.

2.08

CURING MATERIALS

- A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
 - 1. Conform with State of California Air Resources Board VOC Regulations.
 - 2. Products:
 - a. Euclid Chemical Company ; EUCOBAR.
 - b. Kaufman Products Inc; VaporAid.
 - c. W. R. Meadows, Inc ; Evapre or Evapre-RTU.
 - d. Substitutions: See Division 01 - Product Requirements.
- B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309:
 - 1. Type 1, Class A and B, and AASHTO Specification M-148;
 - 2. Type 1, Class A and B requirements, and State of California Air Resources Board VOC Regulations.
 - 3. Sodium Silicate compounds are prohibited.
 - 4. Certified by curing compound manufacturer to not interfere with bonding of floor covering.
 - 5. Product dissipates within 4 to 6 weeks.
 - 6. Products:
 - a. Euclid Chemical Company; COLOR-CRETE CURE AND SEAL VOC.
 - b. W. R. Meadows, Inc; 1100-Clear.
 - c. Substitutions: See Division 01 - Product Requirements.
- C. Curing Agent, Water-Cure Equivalent Type: Clear, water-based, non-film-forming, liquid-water cure replacement agent.
 - 1. Compressive Strength of Treated Concrete: Equal to or greater than strength after 14-day water cure when tested according to ASTM C39.
 - 2. Conform with State of California Air Resources Board VOC Regulations.
- D. Resin Curing Compound: Solvent-based liquid, white pigmented, membrane-forming.
 - 1. For use on exterior slabs. When slab will be painted, sealed, topped, or receive other applied finish, completely remove curing compound after curing is complete and before finish coatings are applied.
 - 2. Comply with ASTM C309, Type 2, Classes A and B.
 - 3. Conform with State of California Air Resources Board VOC Regulations.
 - 4. VOC Content: Less than 200 g/L.
 - 5. Solids Content: 20 percent, minimum.
 - 6. Products:
 - a. Euclid Chemical Company; KUREZ DR-VOX; KUREZ DR-100.
 - b. Kaufman Products Inc; Thinfilm 450 Resin Base.
 - c. Substitutions: See Division 01 - Product Requirements.
- E. Curing and Sealing Compound, Moisture Emission-Reducing, Membrane-Forming: Clear, liquid sealer for application to newly-placed concrete; capable of providing adequate bond for

flooring adhesives, initially and over the long term; with sufficient moisture vapor impermeability to prevent deterioration of flooring adhesives due to moisture emission.

1. Use this product to cure and seal all slabs to receive adhesively applied flooring or roofing.
 2. Comply with ASTM C309 and ASTM C1315 Type I Class A.
 3. Conform with State of California Air Resources Board VOC Regulations.
 4. VOC Content: Less than 100 g/L.
 5. Solids Content: 25 percent, minimum.
 6. Sodium silicate compounds prohibited.
 7. Products:
 - a. Euclid Chemical Company; Diamond-Clear VOX
 - b. Floor Seal Technology, Inc; VaporSeal 309 System.
 - c. Spec Chem; Cure & Seal WB.
 - d. ShawContract; Moisture Shield
 - e. Substitutions: See Division 01 - Product Requirements.
- F. Curing and Sealing Compound, Moisture Emission-Reducing, Penetrating: Clear, water-based, non-film-forming curing agent; capable of providing adequate bond for flooring adhesives, initially and over the long term; with sufficient moisture vapor impermeability to prevent deterioration of flooring adhesives due to moisture emission, moisture vapor emission, and alkalinity.
1. Use this product to cure and seal all slabs to receive adhesively applied flooring or roofing.
 2. Compressive Strength of Treated Concrete: Equal to or greater than strength after 28-day water cure when tested according to ASTM C39.
 3. Chloride Ion Resistance of Treated Concrete: Equal to or greater than strength after 28-day water cure when tested according to ASTM C1202.
 4. Comply with ASTM C309 and ASTM C1315 Type I Class A.
 5. Conform with State of California Air Resources Board VOC Regulations.
 6. Products:
 - a. W.R. Meadows; Pentreat 244.
 - b. Substitutions: See Division 01 - Product Requirements.
- G. Curing and Densifying Compound, Membrane-Forming: Lithium polysilicate-based, clear, liquid densifier for application to newly-placed concrete.
1. Comply with ASTM C309.
 2. Conform with State of California Air Resources Board VOC Regulations.
 3. Solids Content: 25 percent, minimum.
 4. Products:
 - a. BASF; Sonosil.
 - b. Euclid Chemical Company; Eucosil.
 - c. Substitutions: See Division 01 - Product Requirements.
- H. Moisture-Retaining Sheet/Cover: ASTM C171.
1. Provide in a thickness of 42 mils; standard weight of 53 lbs./1000 ft²; tensile strength (machine direction) of 36 lbs./in.; and puncture resistance of 70 lbs.
 - a. Fiber reinforced asphaltic vapor barrier building paper, regular.
 - b. Polyethylene film, white opaque.
 - c. White-burlap-polyethylene sheet.
- I. Absorptive Cover: AASHTO M182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- J. Water: Potable, not detrimental to concrete.

2.09 FLOOR AND SLAB TREATMENTS

- A. Abrasive Aggregate for non-slip finish: Fused aluminum oxide grits, graded 12/30. Use factory graded rustproof and non-glazing material that is unaffected by freezing, moisture and cleaning materials.

- B. Concrete Hardener/Sealer: Clear, water soluble, sprayable in-organic silicate-based hardener/sealer or acrylic co-polymer resin. Shall conform to State of California Air Resources Board VOC Regulations.
- C. Concrete Sealer: Conforming to ASTM C-309, Type I, Class B requirements, and conforming to State of California Air Resources Board VOC Regulations.
- D. Sealer for Colored Concrete: Clear, penetrating, water-based, low-luster sealer recommended by the pigment manufacturer. It shall be compatible with colored concrete components and will not adversely affect concrete color or slip resistance.

2.10 POST-INSTALLED CONCRETE ANCHORS

- A. Expansion Anchors:
 - 1. As indicated on Drawings.
- B. Adhesive Anchors:
 - 1. As indicated on Drawings.
- C. Screw Anchors:
 - 1. As indicated on Drawings.
- D. Grouted Dowels / Grouted Anchors: High strength non-shrink grout to anchor reinforcing steel or threaded rods in concrete.
 - 1. Master Builders; Masterflow 928.
 - 2. Sika Corporation; Sika Grout 212.
 - 3. Substitutions: See Division 01 - Product Requirements.

2.11 REPAIR MATERIALS

- A. High Strength Flowing Repair Mortar: For forming and pouring structural members, or large horizontal repairs, provide the flowable one-part, high strength microsilica modified repair mortar with 3/8" aggregate. The product shall achieve 9000 psi @ 28-days at a 9-inch slump.
- B. Concrete Patching Mortar:
 - 1. Horizontal repairs, ASTM C1059, Type II. Available Products:
 - a. Euclid Chemical Co.; Euco Thin Coat, Concrete Coat.
 - b. Sika Chemical Corp.; Sikatop 121 or 122.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Vertical or Overhead repairs, ASTM C1059, Type II. Available Products:
 - a. Euclid Chemical Co.; Verticoat.
 - b. Sika Chemical Corp.; Sikatop 123.
 - c. Master Builders; Emaco R300, 310 or R350.
 - d. Substitutions: See Division 01 - Product Requirements.
- C. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than specified strength at 28 days when tested according to ASTM C109.
 - 5. Bond Strength: Not less than specified strength at 28 days when tested according to ASTM C1042.
 - 6. Available Products:
 - a. Euclid Chemical Co.; Flo-Top.
 - b. Master Builders; UnderLayment 110.

- c. Substitutions: See Division 01 - Product Requirements.
- D. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150, Portland cement or hydraulic or blended hydraulic cement as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than specified strength at 28 days when tested according to ASTM C109.
 - 5. Product shall exhibit the following properties: Chaplin Abrasion Test – 0.0079-inches maximum at 28 days.
 - 6. Available Products:
 - a. Euclid Chemical Co.; Thin Top SL.
 - b. Master Builders; Topping 112.
 - c. Substitutions: See Division 01 - Product Requirements.

2.12 CONCRETE MIX DESIGN

- A. General:
 - 1. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - a. Procurement of concrete mix design is responsibility of Contractor.
 - b. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
 - c. Contractor shall notify the Testing Laboratory and Architect of intent to use concrete pumps to place concrete so that mix designs can be modified accordingly.
 - 2. Supplementary Cementitious Materials (SCM): Fly ash shall not exceed 25% of the total cementitious material, unless otherwise indicated by Architect and Structural Engineer. Where slag is used to replace cement, slag shall not exceed 25% of the total cementitious material by mass. Ternary systems where more than one supplementary cementitious material is used are prohibited without consent of SEOR.
 - 3. Limit water-soluble, chloride-ion content in hardened concrete to specified percent by weight of cement.
 - 4. Admixtures: Use admixtures according to manufacturer's written instructions.
 - a. Use admixtures in concrete, as required, for placement and workability.
 - b. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - c. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - d. Use corrosion-inhibiting admixture in concrete mixtures where required.
 - 5. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.
- B. Mixtures:
 - 1. Initial mix design shall be prepared for all concrete in accordance with ACI 318 Section 26.4.3. Mix proportions shall be determined in accordance with ACI 318 Section 26.4.3 or 26.4.4. In the event that additional mix designs are required due to depletion of aggregate sources, aggregate not conforming to Specifications or at request of Contractor, these mixes shall be prepared as above.
 - 2. Definition of Mix Properties to be specified for each mix:
 - a. Concrete density, either normal or light weight concrete.

- b. Concrete strength (f'_c) as the minimum compressive strength at a specified number of days, tested in accordance with ASTM C39.
- c. Aggregate size as the largest of the coarse aggregate.
- d. Slump limit. Slump shall be measured at the point of delivery in accordance with ASTM C143 prior to the addition of superplasticizer (if used). Slump tolerance shall meet the requirements of ACI 117 and shall be 4 inch plus or minus 1 inch for general concrete placement. Mixes employing the specified mid-range water reducer shall provide a measured slump not to exceed 7 inch $\pm$ 1 inch after dosing, 2 inch $\pm$ 1 inch before dosing. Use water reducing admixtures as required to provide a workable consistency for pump mixers. Water shall not be added at the jobsite without written review by the structural engineer.
- e. Air entrainment: Provide 6% air entrainment typical for exterior concrete exposed to freeze-thaw cycles. Provide required air entrainment to meet the exposure categories listed in the concrete general notes per ACI 318, Chapter 19.
- f. Air content by volume and may be plus or minus 1.5 percent at point of delivery.
- g. Water/cement ratio is a maximum and specified by weight.
- h. SCM cement replacement ratio as a %.
- i. Drying shrinkage limit (where required) as a percentage change in length after 21 days of drying when tested as per ASTM C157 with 4 inches x 4 inches x 11 inches specimen moist cured 7 days prior to drying.
- j. Fiber reinforcement (where used) specified as weight/volume of concrete.

2.13

MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 or ASTM C685 and ASTM C 1116 (fiber reinforced concrete when applicable), and furnish batch ticket information.
 - 1. The batching plant shall be equipped with an electric metering device capable of determining moisture content of sand.
 - 2. Begin the mixing operation within thirty minutes after the cement has been intermingled with the aggregates.
 - 3. After mix water has been added, concrete shall be mixed not less than 1-1/2 minutes nor more than 1-1/2 hours. Concrete shall be rejected if not deposited within the time specified.
- B. Project-Site Mixing: Use only if method of storing material, mixing of material and type of mixing equipment is approved by Architect. Approval of site mixing does not relieve Contractor of any other requirements of Specifications. Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.
- C. Lightweight Concrete: Mix lightweight concrete in accordance with the directions of the approved lightweight aggregate manufacturer.
- D. Admixtures:
 - 1. Air entrained and chemical admixtures shall be charged into mixer as a solution and shall be dispensed by an automatic dispenser or similar metering device. Powdered admixtures shall be weighed or measured by volume as recommended by manufacturer. Accuracy of measurement of any admixture shall be within plus or minus 3%.
 - 2. Two or more admixtures may be used in same concrete, provided such admixtures are added separately during batching sequence, and provided further that admixtures used in

- that combination retain full efficiency and have no deleterious effect on concrete or on properties of each other.
3. All admixtures are to be approved by Structural Engineer prior to commencing this work.
- E. Re-tempering:
1. Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall be discarded, not re-tempered.
 2. Indiscriminate addition of water to increase slump is prohibited.
 3. When concrete arrives at project with slump below that suitable for placing, water may be added only if neither maximum permissible water-cement ratio nor maximum slump is exceeded. Water shall be incorporated by additional mixing equal to at least half of total mixing time required. Any addition of water above that permitted by limitation of water-cement ratio shall be accompanied by a quantity of cement sufficient to maintain proper water-cement ratio. Such additions shall only be used if approved by Architect. In any event, with or without addition of cement, not more than 2 gallons of water per cubic yard of concrete, over that specified in design mix, shall be added.
- F. Cold Weather Batching:
1. When average of the highest and lowest air temperature falls below 40 degrees F for more than three consecutive days, provide adequate equipment for heating concrete materials. No frozen materials or materials containing ice shall be used. When placed in forms, concrete placed in these temperatures shall have a minimum temperature based on dimensions of concrete sections placed per ACI 301.
- G. Hot Weather Batching:
1. Concrete deposited in hot weather shall have a placing temperature below 95 degrees F per ACI 301. If necessary, ingredients shall be cooled to accomplish this.
- H. Do not use shrinkage-reducing admixture (SRA) in same concrete batch with a moisture vapor reduction admixture (MVRA) or porosity inhibiting admixture (PIA).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

- A. Prior to Work specified in this Section, carefully inspect the installed Work of other trades and verify that such Work is complete to the point where this installation may properly commence.
- B. Formwork: Comply with requirements of Section 03 10 00.
- C. Reinforcement: Comply with requirements of Section 03 20 00.
- D. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- E. Notify the Architect at least 48 hours in advance of the beginning of pouring operations and at the completion of formwork and location of all construction joints. An inspection of forms and joints will be made for approval of finished work and general layout only. The foregoing inspection shall in no way relieve the Contractor of responsibility of design and safety or formwork, bulkheads and shorings.
- F. Ensure Excavations are sufficient to permit placement, inspection, and removal of forms. The entire place of deposit shall have been cleaned of wood chips, sawdust, dirt, debris, hardened concrete and other foreign matter. No wooden ties or blocking shall be left in the concrete except where indicated for attachment of other work.
- G. Concrete surfaces to which fresh concrete is to be bonded shall be brush cleaned to remove all dust and foreign matter and to expose the aggregate, and then coated with the bonding adhesive herein specified.

- H. Prior to placing concrete for any slabs on grade, the moisture content of the subgrade below the slabs shall be adjusted to at least optimum moisture.
- I. Verify geotechnical engineer has approved all foundation excavations.
- J. No concrete shall be placed until formwork and reinforcement has been approved by Architect. Clean forms of all debris and remove standing water. Thoroughly clean reinforcement and all handling equipment for mixing and transporting concrete. Concrete shall not be placed against reinforcing steel that is hot to the touch.
- K. Coordinate:
 - 1. Obtain necessary information for coordination of formwork with items to be embedded in concrete.
 - 2. Coordinate size and location of openings in concrete. Obtain Architect's approval for openings not shown on Structural Drawings.
- L. Discrepancies:
 - 1. Notify the Architect of any discrepancies or inconsistencies.
 - 2. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.
- M. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
 - 1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
 - 2. Use latex bonding agent only for non-load-bearing applications.
- N. Where new concrete with integral waterproofing is to be bonded to previously placed concrete, prepare surfaces to be treated in accordance with waterproofing manufacturer's instructions. Saturate cold joint surface with clean water, and remove excess water before application of coat of waterproofing admixture slurry. Apply slurry coat uniformly with semi-stiff bristle brush at rate recommended by waterproofing manufacturer.
- O. Concrete Slabs on Grade:
 - 1. Bases below exterior and interior slabs on grade shall be accurately leveled and compacted prior to placing of concrete.
 - 2. Unless otherwise indicated, interior slabs on grade shall be poured over a minimum of four (4 inch) inches of compacted crushed rock, over a vapor retarder. Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
 - 3. Protect slab on grade subbase from moisture prior to placing concrete. Avoid wetting rock layer to allow adequate concrete curing and avoid future vapor transmission. If the subbase has been wet excessively, verify that water has been eliminated prior to placement of concrete.

3.03 EMBEDDED ITEMS

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

4. Install concrete accessories in accordance with manufacturer's recommendations: straight, level, and plumb.
- B. Provide pipe sleeves when pipes pass through concrete. Fill voids in sleeves, inserts and anchor slots with readily removable material to prevent entry of concrete into voids. The Contractor shall also see that sleeves have been installed and other provisions have been made for the installation of mechanical, electrical and other equipment.
- C. No conduit shall be cast in concrete unless specifically indicated on the Structural Drawings.
- D. Coring of concrete after placement is not permitted without prior approval by the Engineer of Record.

3.04 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.
- E. Post-Installed Concrete Anchors
 1. Install in accordance with the manufacturer's recommendations and ICC-ES (or IAPMO) reports.
 2. Use washers on all bolts.
 3. Use care to avoid cutting or damaging reinforcing bars.
 4. When exposed to view in the final structure, bolts shall be of a length that will extend entirely through but not more than 1/4-inch beyond the nuts unless otherwise shown on the Drawings.

3.05 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Existing Concrete to New Concrete Joints
 1. Chip keys and roughen existing concrete surfaces where new concrete abuts. Roughen surface by bush-hammering, chipping or sandblasting to remove surface mortar and expose clean aggregate.
 2. Drill and install dowels using epoxy grout in accordance with manufacturer's printed recommendations.
 3. Prime surface with 10-mil layer of epoxy adhesive using a stiff brush. Place concrete while the epoxy adhesive is still tacky. Re-prime if necessary.
- C. Construction Joints: Comply with ACI 318 and install only as indicated and noted on Drawings. Joints not indicated on Drawings shall be so located, when approved, as to least impair strength of structure, and shall conform to typical details. Construction joints shall have level tops, vertical sides. Horizontal construction joints shall be thoroughly cleaned and roughened by removing entire surface film and exposing clean aggregate solidly embedded in mortar matrix. Joints between concrete and masonry shall be considered construction joints. Vertical construction joints need not be roughened unless noted otherwise. See Drawings for doweling and required keys. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement unless otherwise indicated. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. In walls, do not space construction joints more than 60 feet apart in horizontal direction and maximum 20 feet apart in vertical direction unless otherwise shown. In framed slabs and beams, and on metal deck slabs, do not space construction joints more than 120 feet apart. Place construction joints perpendicular to main reinforcement except as otherwise shown. Continue reinforcement across construction joints except as otherwise shown.
 3. Form keyed joints at indicated locations. Embed keys at least 1-1/2 inches into concrete.
 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 7. Roughen surface at all construction joints where key is not used and under baseplates. Roughen concrete surface while concrete is still green where possible. Do not leave laitance, loosened particles of aggregate or damaged concrete at surface. Forms and reinforcing shall be cleaned of drippings. Dampen contact surfaces of construction joints, leaving them free of standing water, before placing fresh concrete. Roughen construction joints by any of following methods:
 - a. By sand-blasting joint.
 - b. By thoroughly washing joint, using a high-pressure hose, after concrete has taken initial set. Washing shall be done not less than 2 hours nor more than 4 hours after concrete has been poured, depending upon setting time.
 - c. By chipping and wire brushing.
 8. All decisions pertaining to adequacy of construction joint surfaces and to compliance with requirements pertaining to construction joints shall be reviewed with the Structural Engineer.
 9. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 10. Before placing regular concrete mix, horizontal construction joint surfaces shall be covered with a layer of mortar composed of cement and fine aggregate of same proportions as that used in prescribed mix but omitting coarse aggregate.
- D. Control Jointing in Slabs-on-Grade: Joints shall be in locations indicated on Drawings, or as directed by Architect. Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints as follows:
1. Construct interior slab control joints as follows:
 - a. By use of construction joints laid out in checkerboard pattern; pour and allow alternate slabs to set; fill out balance of checkerboard pattern with second pour.
 - b. By use of dummy groove joints at least 1/4 depth of slab, and at least 1/8 inch wide. These joints may be sawcut as soon as wet concrete can support the weight of the equipment and operator. Delaying saw-cutting past this point will make jointing ineffective. Use power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
 2. Slab reinforcing need not be terminated at control joints.
 3. Construction and expansion joints shall be counted as control joints.
- E. Isolation/Expansion Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Unless otherwise indicated, use 3/8 inch thick expansion joint filler.
 2. Joints in interior slabs on grade shall be only in locations indicated.

3. Edges of concrete at joints shall be edger finished to approximately 3/8 inch radius.
 4. Interrupt reinforcing at all expansion joints.
 5. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 6. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 are indicated.
 7. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- F. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.
- G. Joint Filling:
1. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - a. Defer joint filling until concrete has aged at least a specified length of month(s). Do not fill joints until construction traffic has permanently ceased.
 2. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
 3. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.06 PLACING CONCRETE

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. Ensure that all foreign material has been removed from surfaces, including reinforcement and embedded items, against which concrete will be placed.
- B. Contractor shall notify the Testing Laboratory and Architect of intent to use concrete pumps to place concrete. Mix designs shall be modified accordingly as required.
- C. The addition of water to the mix after leaving the plant is permitted only when the added water would not cause the mix design water/cement ratio to be exceeded. The addition of water at the site is contingent upon full-time inspection of the process by the owners testing laboratory and the acceptance of the Inspector. Comply with ACI 301, section 4.3.2.1.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
- E. Method: Convey concrete as rapidly and directly as practicable to preserve quality and to prevent segregation. Deposit concrete in forms as nearly as practicable at its final position in a manner which will ensure that required quality is obtained. Chutes shall slope not less than 4 inches and not more than 6 inches per foot of horizontal run.
1. Do not deposit concrete that has initially set. Retempering of concrete, which has partially set, is not permitted.
 2. The maximum time for discharge of concrete shall be per ASTM C94.
- F. Sequence: Pour all walls and columns full height to designated construction joints. Pour all beams, and horizontal structures to designated construction joints. Construction joints to be made in walls only where indicated on the Drawings.
- G. Placement: Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete. Deposit concrete to avoid segregation.
1. Once placing is started, carry it on as a continuous operation until placement of the panel or section is complete. Construction joints to be made only where indicated on the Drawings or on approved shop drawings. Prevent the formation of cold joints at other locations.
 2. Deposit concrete in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. Deposit concrete in a manner to avoid inclined construction joints.

3. Particular care shall be used when starting a concrete pour to maintain the continuity of appearance. Use all means necessary to avoid blemishes, imperfections, or changes in the finish.
 4. Maintain reinforcement in position on chairs during concrete placement.
 5. Deposit concrete into forms in horizontal layers not exceeding 24 inches in thickness around building, proceeding along forms at a uniform rate and consolidating into previous pour. In no case shall concrete be poured into an accumulation of water ahead of pour, nor shall concrete be flowed along forms to its final place of deposit. Fresh concrete shall not be permitted to fall from a height greater than 6 feet without use of adjustable length pipes or, in narrow walls, of adjustable flexible hose sleeves. Concrete shall be scheduled so that placing is a continuous operation for the completion of each section between predetermined construction joints. If any concreting operation, once planned, cannot be carried on in a continuous operation, concreting shall stop at temporary bulkheads, located where resulting construction joints will least impair the strength of the structure. Location of construction joints shall be as shown on the drawings or as approved by Structural Engineer. The rate of rise in walls shall not be less than 2 feet per hour.
- H. Consolidation: Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners. Concrete shall be thoroughly compacted and worked to all points with solid continuous contact to forms and reinforcement to eliminate air pockets and honeycombing.
1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301. Use and type of vibrator shall conform to ACI 309, Guide for Consolidation of Concrete.
 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Place vibrating element directly in concrete and not attached to either inside or outside of forms or to reinforcing steel.
 3. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate. Do not over-vibrate concrete.
- I. Initial Finishing:
1. Screed slab surfaces with a straightedge and strike off to correct elevations.
 2. Where floor drains or floor slopes are indicated, slope slabs uniformly to provide even fall for drainage.
 3. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- J. Concrete Slabs on Grade:
1. Exterior and interior concrete slabs on grade shall be poured as required under this Section. Base shall be accurately leveled and compacted prior to placing of concrete.
 2. Typically, interior slabs on grade shall be poured over a minimum of four (4 inch) inches of clean crushed rock, unless otherwise indicated, over a vapor retarder. Base section shall meet the requirements within the Geotechnical Engineering report.
 3. Protect slab on grade subbase from moisture prior to placing concrete. Avoid wetting rock layer to allow adequate concrete curing and avoid future vapor transmission. If the subbase has been wet excessively, verify that water has been eliminated prior to placement of concrete.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
- K. Concrete Over Metal Deck:
1. At floor slabs, increase fill thickness as required to compensate for deflection of beams and deck at no additional cost to Owner. Obtain specified fill thickness at high points of the deck. Finish floor to specified tolerances for floor flatness, including at concrete over metal deck floors. Refer to 05 30 00 Metal Decking Specification.

2. At roof, maintain specified thickness of concrete uniformly over deck. Slab need not conform to flatness and levelness tolerances
- L. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Concrete placed in these temperatures shall have a minimum temperature based on dimensions of concrete sections placed as shown in ACI 301. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When concrete is expected to be placed at air temperatures of less than 40 deg F, contractor shall review with Architect all special procedures that will be used including mix design modifications and methods of protection. This review shall occur prior to the expected extreme temperatures.
 2. Provide sufficient protection material and equipment on the Project site in advance of the time when the mean daily temperatures are expected to drop below 40 degrees F.
 3. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301. In addition, take precautions including, but not limited to:
 - a. Use non-chloride, non-corrosive accelerating admixture in accordance with previously accepted submittals.
 - b. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - c. Do not use calcium chloride, salt, or other materials containing antifreeze agents unless otherwise specified and approved in mixture designs.
- M. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1 and as follows:
1. When concrete is expected to be placed at air temperatures of greater than 75 deg F, contractor shall review with Architect all special procedures that will be used including mix design modifications and methods of protection. This review shall occur prior to the expected extreme temperatures.
 2. Provide sufficient protection material and equipment on the Project site in advance of the time when the mean daily temperatures are expected to rise above 75 degrees F.
 3. When air temperature exceeds 75 deg F, take special precautions to prevent slump loss, rapid setting, and plastic shrinkage; including but not limited to:
 - a. Maintain concrete temperature below 95 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - b. Keep aggregate piles continuously moist by sprinkling with water. Temperature of Concrete: The temperature of the concrete mix at the time it is being placed in the forms shall not exceed 95 degrees F per ACI 301. The method employed to provide this temperature shall in no way alter or endanger the design mix or the design strength required.
 - c. Use set retarding admixture in accordance with previously accepted submittals.
 - d. Convey, deposit, finish and commence curing of concrete as rapidly as practicable.
- N. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
- O. Minimize evaporation from concrete in place by providing shade and windbreaks. Maintain such protection in place for 14 days minimum.

3.07 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: Surfaces shall be reasonably true to line and plane with no specified requirements for selected facing materials. Tie holes and defects shall be patched and fins exceeding 1/4 inch in height shall be rubbed down with wooden blocks. Fins and other rough spots at surfaces to receive membrane waterproofing shall be completely removed and the surfaces rubbed smooth. Otherwise, remove fins and other projections exceeding a specified height agreed with Architect. Rough finish shall be used for the following areas:
1. Below grade and unexposed surfaces.

- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
- C. Smooth Plywood Form Finish: Finish shall be true to line and plane. Tie holes and defects shall have been patched and ground with surface fins removed. Arrangement of plywood sheets shall be orderly, symmetrical, as large as practical and free of torn grain or worn edges. Surface concrete shall be treated with 1 part muriatic acid, in three parts water solution, followed immediately by a thorough rinsing with clear water. Surfaces which are glazed, have efflorescence, or traces of form oil, curing compounds or parting compounds shall be cleaned or treated to match other formed surfaces, except as otherwise indicated or specified.
 - 1. Smooth Plywood Form Finish shall be used for the following areas:
 - a. All surfaces above grade unless otherwise specified.
 - b. At Contractor's option, may also be used in lieu of rough form finish.
- D. Smooth Plastic Liner Finish: Surface shall be smooth, concrete free of honeycombing, air pockets larger than 1/8 inch in diameter, and fins.
 - 1. This finish shall be used only where indicated on the Drawings.
- E. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 - 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- F. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.
- G. Sacked Surfaces: Exposed surfaces that are unacceptable in appearance to the Architect shall be sacked.
 - 1. Prepare concrete surfaces in accordance with the referenced standards. Remove any form release materials by stoning by hand, power grinding or other method approved by the Architect.
 - 2. Prepare concrete surfaces to receive sack finishing with a light sand blasting.
 - 3. For best results, grout application and rubbing should be performed when areas to be treated are shaded and during cool, damp weather. When work is to be performed in hot and dry weather, a fog spray should be available for continuous use.
 - 4. Prepare grout samples for matching of concrete surfaces for approval by the Architect. These shall be made in the following proportions of gray cement to white cement to sand: 1:1:2, 1:2:3, and 2:1:3, etc. until the correct matching color is obtained on the test areas. Sand should be fine enough to pass the Number 30 sieve. Mixes should be made to a good workable consistency in a clean container and the mix with the best color chosen, or modified if needed.

5. Provide sufficient quantities of sand and cement from the same source for the complete work at the job site.
6. Mixing Application:
 - a. Mixing of grout on the job should be timed for it to be used up within 1 to 1-1/2 hours.
 - b. Let the grout stand 20 to 30 minutes after mixing, and then remixed before applying.
 - c. Soak the concrete surface thoroughly with water at least 15 minutes before applying grout and again just before application so that the surface is adequately wet during the operation.
 - d. Apply grout with plasterer's trowel or sponge rubber float in sweeping strokes from the bottom up. Brush or spray gun applications may be used when approved by the Architect.
 - e. Work in freshly applied grout vigorously with a sponge rubber float, then let sit until some of its plasticity is gone but not until it loses its damp appearance. At this point it shall be rubbed with clean, dry burlap to remove the excess grout, leaving no visible film on the surface but filling all air holes.
 - f. Keep the surface wet for a day after grouting and sack rubbing are completed.
7. Alternate methods of application and materials shall be subject to the approval of the Architect.
- H. Schedule of Concrete Finish Types shall be coordinated with the Architect and indicated on Drawings.

3.08 FINISHING FLOORS AND SLABS (FLATWORK)

- A. Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Unless otherwise indicated or specified, flatwork shall have an integral monolithic finish.
- C. Integral Monolithic Finish: Apply as soon as freshly poured concrete slabs will bear weight of workers. Pour slabs full thickness to finish floor elevations indicated. At proper time, tamp surface repeatedly with a wire mesh or grid tamper in a manner to force aggregate down below surface and to bring sufficient mortar to surface to provide for a smooth coating of cement mortar over entire surface. Allow surface mortar to partially set, then float with wooden floats and finish with one of following, as required.
 1. Broom Finish: Steel trowel surface to a smooth dense surface free of lines, tool marks, cat faces and other imperfections. After troweling, and before final set, give surface a broom finish, brushing in direction noted on Drawings, or as directed. Broom finish shall be used typically on exterior flatwork except as otherwise indicated or specified and shall be "medium" texture as approved by Architect.
 2. Smooth Steel Trowel Finish: Apply 2 steel trowelings to obtain hard, smooth surface. All lips, irregularities, uneven levels, etc. shall be worked out before last troweling. All interior flatwork shall have a smooth steel trowel finish unless specified otherwise.
- D. Slip-Resistive Finish: Before final floating, apply slip-resistive finish. Apply according to manufacturer's written instructions.
- E. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions.

3.09 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. For tolerances not indicated, refer to ACI 117.
- B. Slabs on grade – Comply with FF Floor Flatness & FL Floor Levelness as specified by Architect or Structural Engineer. Where not otherwise indicated, slab shall meet the a Specified overall flatness, $SO_{F_F} = 35$ and Specified overall levelness, $SO_{F_L} = 25$ minimum. Coordinate with Architect flatness and levelness requirements for flooring to be installed prior to placing concrete.
- C. Elevated slabs – Comply with Architectural or Structural Engineer requirements.

- D. Comply with flatness and levelness tolerances per ASTM E 1155 for randomly trafficked floor surfaces. Measure FF Floor Flatness and FL Floor Levelness within 48 hours after slab installation; report both composite overall values and local values for each measured section.
- E. Slabs supporting modular office partitions, adhered flooring systems, or compact storage shelving must also comply with the manufacturer's tolerance requirements.
- F. Slabs scheduled to receive wood flooring must also comply with tolerances required for installation of wood flooring.
- G. Finished surfaces of exterior integral finished flatwork shall not vary more than 1/4 inch from a 10' long straightedge, except at grade changes.
- H. Fill or grind completed slabs as necessary to achieve specified finish tolerances. Fill shall be with a self-leveling cementitious product capable of being tapered to a feathered edge.
 - 1. Repair any slab section measuring below either the minimum local F-number or the minimum local L-number.

3.10 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
 - 2. As a minimum, shoring shall remain in place for the following periods:
 - a. Walls and Columns: 2 days
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.11 CONCRETE SURFACE REPAIRS

- A. Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval. Repair and replacement work will be done at Contractor's expense.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Slabs on Grade: After entire slab is finished, shrinkage cracks that may appear shall be patched as follows:
 - 1. Where slab is not exposed or where appearance is not important, cracks larger than 1/32 inch wide shall be filled with cement grout and struck off level with surface.
 - 2. Where slab is exposed and appearance is important, unsightly cracks shall be repaired in a manner satisfactory in appearance to Architect. If this cannot be accomplished, concrete shall be considered defective.
- D. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Honeycombed areas shall be removed down to sound concrete, coated with a bonding grout or approved compound and patched using a low shrinkage high bond mortar. Patched areas shall be cured by being kept damp for at least 5 days.

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

3.12 CURING AND PROTECTION

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing. Concrete shall be maintained at not less than 50 degrees F nor more than 100 degrees F for a period of 72 hours after being deposited.
- B. Protection: Contractor shall be responsible for protection of finished concrete against injury by rain, cold, vibration, animal tracks, marking by visitors, vandalism, etc.
- C. Provide additional curing agents or compounds, not necessarily listed herein, but as recommended and or required for use with shake type hardeners or other special coatings and coverings by their manufacturers for a complete and proper installation.

- D. Where supplementary cementitious materials are used, extra precautions shall be taken to prevent premature drying.
- E. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- F. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period. Forms heated by sun shall be kept moist during curing period.
- G. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- H. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven (7) days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven (7) days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
 - 5. Interior slabs to receive adhesive-applied or resilient flooring: Cure only with moisture retaining cover. Do not cure with curing compound.
 - 6. Interior slabs to receive thin set of tile: Cure only with moisture retaining cover. Do not cure with curing compound.
- I. Flatwork: Flatwork to be exposed, stained, or painted shall have curing process submitted and approved by the architect prior to construction.
 - 1. Initial Curing Process:
 - a. Mist Spraying: As soon as troweling of concrete surfaces is completed, exposed concrete shall be sprayed continuously with a special atomizer spray nozzle, capable

of producing a fine mist. Spraying shall be done without any dripping of water from nozzle. Amount of spraying shall be such as to maintain surface of concrete moist without any water accumulating on surface. Maintain spraying for a minimum of 12 hours, or until such time as hereinafter described curing process is applied. Mist spraying will not normally be required when the ambient air temperature is below 90 degrees F.

2. Final Curing Process:

- a. Water Curing: Concrete shall be kept wet by mechanical sprinklers or by any other approved method which will keep surfaces continuously wet.
 - b. Saturated Burlap Curing: Finished surfaces shall be covered with a minimum of two layers of heavy burlap which shall be kept saturated during the curing period.
 - c. Curing Compounds: Membrane curing compounds of chlorinated rubber or resin type conforming to ASTM C309 may be used only if specifically approved by Architect. Use of membrane curing compound will not be permitted on surfaces to be painted, or to receive ceramic tile, membrane water-proofing or hardeners and sealers. Membrane curing compound may be used in areas to receive resilient floor tile, provided it is wax-free, compatible with adhesive used and approved by adhesive manufacturer. Agitate curing compounds thoroughly by mechanical means continuously during use and spray or brush uniformly in accordance with manufacturer's recommendations. Apply immediately following final finishing operation. All curing compounds shall conform to State of California Air Resources Board VOC Regulations.
 - d. Waterproof paper conforming to ASTM C 171, or opaque polyethylene film, may be used. Concrete shall be covered immediately following final finishing operation. Anchor paper or film securely and seal all edges in such a manner as to prevent moisture escaping from concrete.
- J. Refer to Drawings for areas of concrete slab not to receive curing compounds or hardening compounds. Where concrete floors are to receive heavy duty coatings, waterproof coatings and the like, verify with coating installer the type of finish required for specified coating.

3.13 SURFACE HARDENER AND SEALER

- A. Seal all interior exposed flatwork with clear sealer, except surfaces receiving ceramic tile, quarry tile, poured flooring or other special finishes specified, or as scheduled on the Drawings.
 1. Apply sealer in 2 or 3 coats, in accordance with manufacturer's directions, using the maximum quantity recommended.
 - a. Concrete floors must be thoroughly cured for a minimum of 30 days and completely dry before treatment.
 - b. Surfaces to be treated must be clean, free of membrane curing compounds, dust, oil, grease and other foreign matter.
 - c. Upon completion, concrete surfaces shall be clean and without discoloration or traces of excess hardener left on the surface.
- B. Apply sprayable hardener/sealer at locations as scheduled or as indicated on the Drawings. Apply in accordance with the manufacturer's favorably reviewed application instructions and recommendations.

3.14 GROUTING

- A. Prepare and place grout materials at locations as indicated on the Drawings in accordance with the manufacturer's recommendations and installation instructions.
- B. Pack grout materials solidly between bearing surfaces and bases or plates as indicated and to ensure no voids.

3.15 DEFECTIVE CONCRETE

- A. Defective concrete shall mean any of the following:
 1. Concrete not meeting 100 percent of the specified 28 day compressive strength.

2. Concrete exhibiting rock pockets, voids, spalls, streaks, cracks, honeycombing, that has any sawdust, wood, or debris embedded in it, or is otherwise defective, and in the Architect's judgment these defects impair the proper strength or appearance of the work
 3. Exposed reinforcing to extent that strength, durability, or appearance is adversely affected.
 4. Concrete significantly out of place, line, or level.
 5. Concrete not containing the required embedded items.
 6. Any concrete work not in accordance with the Specification and Drawings.
- B. Upon determination that concrete strength is defective:
1. Should cylinder tests fall below minimum strength specified, concrete mix for remainder of work shall be adjusted to produce required strength. Core samples shall be taken and tested from cast-in-place concrete where cylinders and samples indicate inferior concrete with less than minimum specified strength.
 - a. Cores of hardened concrete shall be taken and tested in accordance with ASTM C 42 and C 39. Number and location of such cores shall be subject to the approval of Architect.
 - b. Cost of core sampling and testing will be paid for by the Contractor.
 - c. "85 percent" reduction in ACI 318 Section 26.12.4 will not justify low cylinder tests.
- C. Upon determining that concrete surface is defective, Contractor may restore concrete to acceptable condition by cutting, chipping, pointing, patching, grinding, if this can be done without significantly altering strength of structure. Permission to patch defective areas will not be considered a waiver of the right to require removal if patching does not, in the opinion of the Architect, satisfactorily restore quality and appearance.
- D. If core tests indicate that concrete is below the strength specified, or if patching does not restore concrete to specified quality and appearance, the concrete shall be deemed defective, and shall be removed and replaced without additional cost to the Owner.
- E. No repair work shall begin until the procedure has been reviewed by the Architect and Structural Engineer.

3.16 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Post-installed concrete anchors, per ICC-ES or IAPMO recommendations.
 5. Verification of use of required design mixture.
 6. Concrete placement, including conveying and depositing.
 7. Curing procedures and maintenance of curing temperature.
 8. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Provide special inspections and testing as described in the "Statement of Structural Special Inspections and Testing" within the structural drawings and as required by this section.
1. A testing program is required prior to start of construction. Testing program to be done in Compliance with the CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.
 2. The following tests shall be made by a recognized testing laboratory selected by the Owner and approved by the governing agency. All tests shall be in accordance with the

previously mentioned standards and ACI 318 Section 26.12. A complete record of all tests and inspections shall be kept per CBC Section 1903.1.

- a. Compressive Strength: Make and cure in accordance with ASTM C31. Test in accordance with ASTM C39 and ACI 318 Section 26.12.
 - 1) A record shall be made of time and of locations of concrete from which samples were taken.
 - 2) Four identical cylinders shall be taken from each pour of 150 cubic yards or 5000 square feet or part thereof, being placed each day per ACI 318 Section 26.12.2. One cylinder shall be tested at age 7 days, and two at age 28 days unless otherwise specified. Preserve remaining cylinder for future use.
- b. Drying Shrinkage: (applies to lightweight concrete only unless noted otherwise).
 - 1) A record shall be made of time cylinders and of locations of concrete from which samples were taken.
 - 2) Three identical 4" x 4" x 11" specimens shall be made from same concrete as used in structure. Percent of shrinkage shall be reported at 21 days after 7 day moist curing period. Average results of 3 specimens shall be used as the accepted value. The value for laboratory cast specimens shall not exceed .075%. If field test specimens are used in lieu of laboratory specimens, a tolerance of +33% may be used.
 - 3) Test specimens in accordance with ASTM C157.
- c. Concrete consistency (slump) shall be tested in accordance with ASTM C143. Perform one slump test for each set of test cylinders taken.
3. Provide full time inspection per CBC Section 1704.3 during the taking of test specimens and during the placing of all concrete and embedded steel.
4. Provide concrete batch plant inspections per ASTM C685.
- D. Reinforcing Steel
 1. See Section 03 20 00.
- E. Survey and Adjustment: Continuously observe formwork operations, record such observations on a daily basis, and submit reports of the results. Instrument check forms before and during concrete placement to assure no movement has taken place. Make appropriate corrections to reposition displaced forms.
 1. Measure floor and slab flatness and levelness as specified in "Floor Flatness and Levelness Tolerances" Section.
 2. Certify, by written report submitted on a weekly basis, for each level and story that the elevations, finish lines and building lines of the hardened concrete are within tolerances, as substantiated by transit survey; also that all embeds and inserts have been installed within tolerance.
- F. Slab Testing: Cooperate with manufacturer of specified moisture vapor reducing admixture (MVRA) to allow access for sampling and testing concrete for compliance with warranty requirements.
- G. Permeability Test: Test concrete with waterproofing admixture according to COE CRD-C 48.

3.17 ADJUSTING AND CLEANING

- A. Remove all debris, excess materials, tools and equipment resulting from or used in this operation at completion of this work.
- B. Surfaces to be painted shall be smooth and free of substances such as dirt, wax, excessive laitance, grease or materials that would prevent proper bonding of finishes.
 1. Removal of foregoing contaminants, and complete removal of parting and curing compounds affecting proper paint bond, shall be responsibility of this Section of Work. Sandblast cleaning shall not be employed without specific approval of Structural Engineer.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Structural steel framing members.
- B. Structural steel support members, plates, and bracing angles.
- C. Bolts, washers, and other steel accessories.
- D. Base plates, shear stud connectors and expansion joint plates.
- E. Grouting under base plates.
- F. Prime coat painting and touch up.
- G. Templates for cast-in-place anchor bolts.

1.03 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications.
- B. Division 07 - Applied Fire Protection: Fireproof protection to framing and metal deck systems.
- C. Division 09 - "Paintings and Coatings" for surface-preparation and priming requirements.

1.04 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by American Institute of Steel Construction (AISC) 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Heavy Sections: Rolled and built-up sections as follows and subjected to special notch toughness, fabrication, welding and inspection requirements as defined in this specification:
 - 1. Shapes included in ASTM A6 with flanges thicker than 2 inches.
 - 2. Welded built-up members with plates thicker than 2 inches.
 - 3. Column base plates thicker than 2 inches.
 - 4. All ASTM A6 shapes with flange thickness greater than 1-1/2 inches that are part of the Seismic Force Resisting System.
 - 5. Welded built-up members with plates thicker than 1-1/2 inches if part of the Seismic Force Resisting System.
- C. Seismic Force Resisting System (SFRS): These elements are those which resist seismic loads and include braced frames, moment frames and collector elements and are indicated on the drawings.
- D. Protected Zone: Areas of critical members in the Seismic Force Resisting System that are expected to behave inelastically during a seismic event. Refer to the Structural Drawings for designation of the Protected Zones. Within the Protected Zones, the following shall apply:
 - 1. Discontinuities created by fabrication or erection operations such as tack welds, erection aids, air-arc gouging and thermal cutting shall be repaired as required by the Structural Engineer.
 - 2. No welded shear studs and decking attachments (excluding decking arc spot welds) shall be placed on beam flanges.
 - 3. No welded, bolted, screwed, or shot-in attachments for edge angles, exterior facades, partitions, duct work, piping and other construction.
- E. Demand Critical Welds (DCW): Welds in the Seismic Force Resisting System which invoke special welding and inspection requirements in this specification. Welds shall be considered

DCW on this project as defined for each SFRS indicated in AISC 341 and as otherwise indicated on the Drawings as DCW.

1.05 REFERENCE STANDARDS

- A. Utilize the edition of the listed document as identified in the "Design Criteria Notes" in the structural drawings. If not listed in the "Design Criteria Notes", use the edition adopted or referenced by the listed Governing Building Code or material standard. If no specific edition is adopted, use the latest edition.
1. AISC 360 - Specification for Structural Steel Buildings
 2. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges.
 3. AISC 341 - Seismic Provisions for Structural Steel Buildings.
 4. AISC 358 - Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications.
 5. ASTM A36 - Standard Specification for Carbon Structural Steel.
 6. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 7. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 8. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 9. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 10. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
 11. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 12. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 13. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nut.
 14. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 15. ASTM A913 - Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process
 16. ASTM A992 - Standard Specification for Structural Steel Shapes.
 17. ASTM A1085 - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
 18. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
 19. ASTM E94 - Standard Guide for Radiographic Examination Using Industrial Radiographic Film.
 20. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments.
 21. ASTM E165 - Standard Practice for Liquid Penetrant Testing for General Industry.
 22. ASTM E709 - Standard Guide for Magnetic Particle Testing.
 23. ASTM F436 - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
 24. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
 25. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
 26. AWS D1.1 - Structural Welding Code.
 27. AWS D1.8 - Structural Welding Code – Seismic Supplement.
 28. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections.
 29. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.

30. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).
31. SSPC-SP 1 - Solvent Cleaning.
32. SSPC-SP 2 - Hand Tool Cleaning.
33. SSPC-SP 3 - Power Tool Cleaning.
34. SSPC-SP 6 - Commercial Blast Cleaning.
35. UL (FRD) - Fire Resistance Directory Current Edition.

1.06

SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 1. Direct copies (including electronic versions) of SEOR plans and details are not allowed. Using SEOR plans as a background for the development of the submittal plans is acceptable.
 2. Submit shop drawings to Architect for review and obtain Architect's acceptance prior to start of fabrication. Where shop drawings are resubmitted, the Contractor shall cloud and identify all changes made due to additions, deletions, and corrections to the shop drawing. Shop drawings resubmitted without each change being clouded and identified will be returned for resubmission.
 3. Shop drawings shall include complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.
 4. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed by others.
 5. Include layout, member size, and weights, materials used, and beam marks as well as orientation and relation of members to appropriate grid lines and setting elevations for column bases. Reference shop drawings to specific location and detail number on the Structural Drawings.
 6. Include details of cuts, connections, splices, camber, holes, openings, doubler plates, stiffeners and other pertinent data, including bolt hole sizes, connection materials, and welded joint designations.
 7. Include embedment drawings.
 8. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 9. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections.
 10. Indicate surface preparation and finishes.
 11. Submit plans of all levels locating the edge of slab at perimeter and at interior openings at locations where bent plate closure occurs.
 12. Identify members and connections of the Seismic-Force-Resisting System (SFRS).
 13. Indicate locations and dimensions of protected zones.
 14. Identify welds that are part of the SFRS.
 15. Identify Demand Critical Welds.
 16. Shop drawings shall include connection details drawn to scale for members of the Seismic Force-Resisting System.
 17. Dimensions required to locate structural steel for manufactured items such as mechanical equipment, electrical equipment, dock levelers, etc., shall be coordinated and provided by the General Contractor. General Contractor shall also coordinate and provide dimensions to locate structural steel for window washing supports such as davits, tie-backs, etc.
 18. Connections required but not specifically referenced.
- C. Erection Procedures:
 1. Submit procedures, methods, sequences of erection, temporary shoring and guying, and equipment proposed for erecting structural steel. Erection procedures are submitted for record only and therefore will not be returned to the Contractor.
- D. Bearing Assemblies:

1. Submit shop drawings and technical specifications for the slide bearing assemblies used in the project.
- E. Jacking and Tensioning Procedures:
1. Submit procedures, methods, sequences of jacking and tensioning, instrumentation and monitoring devices if implemented within the project.
- F. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code - Steel," AWS D1.8, "Structural Welding Code – Seismic Supplement," and AISC 341 for each welded joint whether prequalified or qualified by testing, including items listed below. All submitted Procedures shall be reviewed by the Testing Agency prior to use on the project. The Procedures will be submitted to the Engineer for review after review by the testing agency is complete.
1. The WPSs and PQRs shall include all essential variables and parameters required by AWS D1.1 and AWS D1.8.
 2. Where backgouging is required provide back gouging criteria (e.g. smoothness, grinding, gouge shape, inspection by the welder, etc.) per AISC 341, AWS D1.1, and AWS D1.8.
 3. Explicitly note which WPSs will be used for welding of members and connections of the SFRS and Demand Critical Welds.
 4. For multi-pass welds define sequence and layering of passes.
 5. Welding Procedure Qualification Record (WPQR) Tests: For WPSs that are not pre-qualified per AWS D1.1, submit the supporting WPQR tests results conducted in accordance with AWS D1.1 along with the corresponding WPS.
 6. When the required effective throat thickness of flare groove welds is larger than allowed by Table J2.2 of AISC "Steel Construction Manual", submit data establishing by qualification the consistent production of such larger effective throat thickness. Qualification of effective throat thickness shall be as required by the AISC specification.
 7. For non-prequalified, complete butt or groove welds of the SFRS, include CVN weld test records.
 8. In addition to the WPS submit fabrication and erection procedures where needed to control shrinkage, fabrication tolerances, or to insure proper inspections.
 9. Include CVN tests, requirements and procedures in compliance with AWS D1.1, AWS D1.8 and the requirements of the contract documents. Test temperature shall be specified herein. Where specified CVN properties in the contract documents exceed the minimum requirements in AWS D1.1 / AWS D1.8, CVN tests shall be performed to the properties in the contract documents.
 10. All welds for the SFRS are according to AWS D1.8 as a minimum.
 11. WPS and WPQR's shall include specific reference to the manufacturers make and model of weld material. Provide manufacturer's data sheet for all weld material indicating recommended welding parameters and variables.
- G. Weld Shrinkage and Distortion Procedures: Submit weld shrinkage and distortion procedures for all welded connections where distortion due to weld shrinkage may cause damage to the steel material. The welding sequence and procedures are to minimize the effect of weld shrinkage, residual stresses, and to maintain erection tolerances. These procedures shall be reviewed by Testing Agency, and then used by Testing Agency to verify conformance. As a minimum, procedures shall be submitted for the following connections:
1. Welding of continuity plates and doubler plates into the WF columns.
 2. Field welding beam-to-column connection (include beam flange welds, rib welds, connection plate bolting and weld).
 3. Welding columns to base plates.
- H. Fastener Installation Procedures: Submit written procedures for the pre-installation testing, installation snugging, pre-tensioning, and post-installation inspection of fasteners. The procedures shall meet all requirements of the Research Council on Structural Connections (RCSC) "Specification for Structural Joints Using ASTM A325 or A490 Bolts" and the Contract

Documents. Provide installation procedure and inspection for direct tension indicator washers detailed in supplemental specifications provided by the manufacturer for approval.

- I. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
- J. Mill test reports for structural steel, including chemical and physical properties, regardless of thickness or use. Reports shall comply with ASTM A6 and be submitted to the Owner's Quality Assurance Agency.
 - 1. Submit a mill report for each heat of steel used, and certified fastener reports for all fasteners, including nuts, washers and direct tension indicators prior to the start of fabrication. For unsatisfactory mill test report, retest steel.
 - 2. Include Charpy test results for heavy sections and for materials where Charpy values are specified. Testing required per AISC 360 section A3.1c and AISC 341 section A3.3 and as specified herein.
 - 3. Mill test reports shall include ladle analysis and tensile elongation.
 - 4. Mill reports shall be traceable to individual pieces of steel used.
 - 5. In addition to other requirements mill reports shall address the following elements: copper, columbium, chromium, nickel, molybdenum, silicone, and vanadium.
 - 6. Provide mill reports for all welding consumables used on this project.
- K. Fabricator Test Reports: Comply with ASTM A1011.
- L. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1 and dated no more than 12 months before start of scheduled welding work. Submit to welding special inspector for approval. Submit final copies to Architect for review.
- M. General Contractor Verification of Compliance for Materials: General Contractor's review and acceptance shall be included with each submittal stating that the Contractor has reviewed the submitted manufacturer's test reports and certifications, and that the materials being furnished for the project are in conformance with the applicable standards and project documents. The review shall be submitted along with the manufacturer's test reports and certifications for structural steel, fasteners, welding filler metals, and shear studs.
- N. Product Test Reports and Certifications: Submit manufacturer's test reports and certifications as listed below. Test Reports and Certifications are submitted for record only and therefore will not be returned to the Contractor. A copy of the test reports and certifications shall be sent to the owners Quality Assurance Agency. The Contractor Certificate of Compliance letter shall accompany the Manufacturer's Certifications.
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis. Certifications for high strength bolts shall conform to certification requirements contained in ASTM A325, A490, F1852, F2280.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength bolt-nut-washer assemblies.
 - 4. Shear stud connectors. Shear studs, as supplied, shall meet the requirements of AWS D1.1, Sections 7.2 and 7.3.
 - 5. Shop primers.
 - 6. Nonshrink grout.
 - 7. Welding electrodes, fluxes and shielded gas products. Certifications shall satisfy the applicable AWS A5 and project requirements.
 - 8. Spray-on fireproofing. Submit certificate issued by paint manufacturer ensuring compatibility between the primer and the spray-on fireproofing.
- O. Submit fabricators identification mark system to Testing Agency prior to fabrication.
- P. Fabricator's Qualification Statement.
- Q. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

- R. As-Built Drawings: At the end of the work included in this Section submit a complete set of reproducible drawings incorporating all changes, additions and deletions to the Construction Drawings due to revisions, change orders, field conditions, or any other reason.

1.07

QUALITY ASSURANCE

- A. Comply with the referenced ASTM standards for materials.
- B. Verification of accuracy:
1. Engage and pay for a registered Professional Engineer or licensed Land Surveyor to check the alignment, plumbness, elevation, and overall accuracy of the erected framing at appropriate stages during construction and at completion of erection. Prior to erection, a survey shall be made of the as-built locations of all anchor rods and other embedded items associated with the attachment of structural steel. The party providing the survey shall submit written verification that the entire installation is in accordance with the contract documents and meets the allowable erection tolerances as set forth in the AISC "Code of Standard Practice for Steel Buildings and Bridges".
 2. Columns shall be verified at each lift. Column shim details and procedures shall be submitted for review.
- C. Tests and Inspections: Provide special inspections and testing as described in the "Statement of Structural Special Inspections and Testing" within the structural drawings and as required by this section.
1. Unless waived in writing by the Architect and the Authority Having Jurisdiction, all materials, work, methods and equipment shall be subject to inspection at the mill, fabricating plant and at the building site. Material or workmanship not complying fully with the Contract Documents will not be accepted. The Contractor shall give the Testing Laboratory reasonable notice when ready for inspection and shall supply samples and test pieces and all facilities for inspection without extra charge.
- D. Testing Agency: Shop and field testing and inspection of steelwork specified in this document or requested by the Owner will be performed by an independent agency engaged by the Owner.
1. The Testing Agency shall be furnished with the following:
 - a. One complete set of fabrication and erection drawings.
 - b. Material bills, cutting lists, order sheets and mill test reports.
 - c. Information regarding time, place of rolling and shipment of materials to shop.
 - d. If requested, representative sample pieces for testing.
 - e. Full and ample means and assistance for testing materials.
 - f. Access and facilities, including scaffolding, temporary work platforms, etc., for testing and inspection at all places where materials or components are stored, fabricated or erected in the mill, shop or field.
 - g. Complete set of welding procedures.
 - h. Welder qualifications.
 - i. Reports for all Contractor tests and inspections.
 2. In addition to the work specified elsewhere in the Contract Documents, the Testing Agency shall review the following for compliance with project specifications:
 - a. Fastener Installation Procedures.
 - b. WPSs and WPQRs.
 - c. Manufacturer's Test Reports and Certifications.
 - d. Welder qualification.
- E. Comply with applicable provisions of the governing building code, reference standards, specifications, and documents, except where more stringent requirements are shown or specified.
- F. Structural steel members designated as architecturally-exposed structural steel (AESS) to also comply with Section 05 12 13.

- G. All work shall be performed by qualified operators experienced in their field of work and as otherwise required by these specifications.
- H. Fabricator Qualifications: a fabricator that regularly fabricates structural steel members and components specified in the contract documents, demonstrating satisfactory service on a minimum of five (5) similar installations for a minimum of five (5) years.
- I. Shop-Painting Applicators: A qualified applicator with a minimum of 12 months prior experience working with the fabricator.
- J. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1 for each process, position and joint configuration. Each operator shall have been qualified as prescribed by AWS and shall be approved by the Testing Agency. Qualification performed more than six months prior to the start of the welding by the welder is acceptable, provided written documentation is submitted showing that the welder has continued to use the applicable welding process on an ongoing basis since the test was conducted, with no lapse in service exceeding six months.
1. Welder Certificates shall be submitted to Testing Agency prior to welding.
 2. Welders shall be checked by welding inspector. Those not doing satisfactory work may be removed, and may be required to pass qualification tests again. All qualification testing shall be at the Contractor's expense.
 3. Require welders to retake the qualification test if, as determined by the Architect or Testing Agency, there is a reasonable doubt as to the proficiency of the welder. If the welder does not requalify, he shall not perform any welding on the project.
 4. In addition to AWS D1.1 requirements on welder Qualification, qualify welders making welds with restricted access (such as welding the bottom flanges of girders to column flanges through cope or access holes in the girder webs) by using a mock-up assembly identical to the actual conditions of producing weldments in the field, using the approved WPS.
 5. Welder qualification shall include passing the bend test.
 6. Welders and welding operators performing work on Demand Critical Welds, beam bottom flange to column welds, or welds that must be made by welding through a beam access hole shall pass the supplemental welder qualification testing, as required by AWS D1.8.
 - a. Supplemental Qualification test shall be in accordance with AWS D1.8. The qualification test specimens shall be made with the same electrodes, processes and welding procedures that will be used on this project and also using the highest weld deposition rate allowed by the WPS.
 - b. Documentation showing that a welder has passed a similar qualification test within the last 36 months will be acceptable if in the opinion of the Testing Agency the test meets the criteria.
 - c. Testing Agency will perform and/or witness the tests on the qualification test specimen.
 - d. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- K. Contractor's Quality Control Plan: Quality Control includes the functions performed by the Contractor to ensure that the material and workmanship of structural steel construction meets the project specifications and applicable standards. The Contractor shall submit a Quality Control Plan that addresses all inspection issues, including fabrication/erection testing and inspection per AWS D1.1, AWS D1.8 and AISC 341 Chapter J. The verification testing and inspection carried out by the Testing Agency does not relieve the contractor of the responsibility for conducting their own quality control/inspection program to ensure the requirements of the Contract Documents have been met. The Contractor's Quality Control Plan will be reviewed by the Testing Agency.
- L. Protected Zone: The Contractor's Quality Control Plan shall include procedures that will be followed to ensure the Protected Zone is clearly identified on the required elements of the

Seismic Load Resisting System and all necessary subcontractors are made aware of the requirements of this section.

- M. Quality Control Inspector Qualifications: Along with Quality Control Plan, Contractor shall submit written qualifications for all inspectors to be assigned Quality Control functions for structural steel work, including general inspection, bolting inspection, welding inspection, and non-destructive testing. Qualifications for welding inspectors shall show evidence of ability to monitor all WPS variables, check weld sizes, and visually detect weld defects.
- N. Prefabrication and Preinstallation Conference: Prior to performing fabrication or erection work, there shall be a pre-fabrication and pre-erection meeting to review welding procedures, bolting procedures, and inspection requirements for all welding and bolting operations. The meeting shall include the following individuals: Owner's Representative, Testing Agency, Special Inspector, Steel Fabricator and Erector personnel supervising the shop, field and Quality Control work.
- O. Paint:
 - 1. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use thinners approved by paint manufacturer, and use within recommend limits.
 - 2. Coordination of Work: Review other Sections in which prime paints are to be provided to ensure compatibility of coatings system for various substrates. Upon request, furnish information or characteristics of finish materials to be used.
 - 3. Requirements of Regulatory Agencies: Comply with applicable rules and regulations of governing agencies for air quality control.
- P. Maintain one copy of each document on site.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
- C. Requirements for storage and handling of electrodes shall be per AWS D1.1 and AWS D1.8. Additional requirements include:
 - 1. Long term storage of weld consumables shall be indoors, where moisture or dew does not collect, and in undamaged manufacturer's shipping bags, boxes, and containers.
 - 2. Open Flux Cored Arc Welding (FCAW) electrodes shall be completely covered during hours of non-use (i.e., weekends, nights of nonuse, days of nonuse, etc.). Where rain or dew could be expected to collect (i.e., open floors of erection site, open shop bays, etc.), electrodes shall also be covered.
 - 3. Electrode Storage and Exposure Limits for Demand Critical Welds: The exposure time limit for electrodes shall be in conformance with AWS D1.8 Section 6.4.

1.09 COORDINATION

- A. Surveys: Contractor shall conduct field surveys and field verification as required to incorporate existing conditions from previous works, such as foundations and existing buildings, to the work before shop drawings are produced.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions for installation.
- C. Notify the Owner's Representative in sufficient time prior to shop or field fabrication or erection to permit testing and inspection without delaying work.
- D. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All hot rolled steel shapes, plates, and bars shall be new steel conforming to ASTM A6, unless otherwise noted in the Drawings. Structural steel shall be as follows:
 - 1. Wide Flange and WT Shapes: ASTM A992.
 - 2. M- and S- Shapes: ASTM A572 Gr.50.
 - 3. C- and MC- Shapes: ASTM A992.
 - 4. L- Shapes: ASTM A572 Grade 50.
 - 5. Round HSS: ASTM A500 Grade C (Fy = 50 ksi).
 - 6. Rectangular HSS: ASTM A500 Grade C (Fy = 50 ksi).
 - 7. Pipe: ASTM A53, Grade B (Fy = 35 ksi).
 - 8. Base Plates up to 4" thick: ASTM A572 Grade 50.
 - 9. All other Plate Material: ASTM A572 Grade 50.
 - 10. Built-Up Columns: ASTM A572 Grade 50.
 - 11. Plate Girders: ASTM A572, Grade 50.
 - 12. Connection Material:
 - a. Column Continuity Plates and Doubler Plates: ASTM A572 Grade 50.
 - b. Brace Frame Gusset Plates: ASTM A572 Grade 50.
- B. Heavy sections as defined in this specification: ASTM A36 and/or ASTM A572 Grade 50 with supplementary requirements S5 Charpy V-Notch Impact Test and ASTM A6 with supplementary requirements S91 Fine Austenitic Grain Size. For location of Charpy V-Notch test, see ASTM A6 Supplementary Requirement S30. Charpy V-Notch test shall be per ASTM A673, frequency P and shall meet a minimum average value of 20 ft-lbs absorbed energy at 70 degrees Fahrenheit.
- C. Steel using complete joint penetration groove welds that fuse through the thickness of the flange or web that is part of the SFRS shall have a minimum Charpy V-notch impact testing value of 20 ft-lbs at 70 degrees Fahrenheit.
- D. Heavy Sections in the Seismic Force-Resisting System shall be supplied with Charpy V-notch (CVN) testing in accordance with AISC 341 requirements.
- E. Welding Materials
 - 1. Welding Material: Filler metal requirements shall conform to AWS D1.1, and AISC "Specification for Structural Steel Buildings". Filler metal used in welds designated as part of the SFRS or as Demand-Critical shall comply with AWS D1.8. Minimum classified tensile strength of 70 ksi (E70). Use low hydrogen electrodes as defined by AWS D1.1, unless noted otherwise. For all CJP welds used on Heavy Structural Sections that are not part of the Seismic Load Resisting System the filler metal shall have a Charpy V-Notch (CVN) toughness of at least 20 ft-lb at 70 degrees Fahrenheit.
 - 2. Welding Materials for Seismic Force Resisting System:
 - a. All filler metal used in the Seismic Load Resisting System shall have a Charpy V-Notch (CVN) toughness not less than of 20 ft-lb at 0 degrees Fahrenheit, using AWS A5 classification test methods.
 - b. Filler metal for welds defined as Demand Critical Welds (DCW) shall have a Charpy V-Notch (CVN) toughness of 20 ft-lb at minus 20 degrees Fahrenheit as determined by the appropriate AWS classification test method and 40 ft-lb at 20 degrees above the lowest anticipated service temperature of the structure as determined by AISC 341 and AWS D1.8.
 - c. Refer to AISC 341 and AWS D1.8 for additional filler metal requirements.
- F. Bolts, Connectors, and Anchors
 - 1. High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy-hex steel structural bolts unless noted otherwise; ASTM A563, Grade C heavy-hex carbon-steel nuts or equal per ASTM A325-10 Section 3.2; and ASTM F436, Type 1, hardened carbon-steel

- washers; all with plain finish. ASTM F1852 Twist-Off Type Torque Control Bolts are a suitable alternative to ASTM A325 bolts.
2. High-Strength Bolts, Nuts, and Washers: ASTM A490, Type 1, heavy-hex steel structural bolts, where noted on drawings; ASTM A563, Grade DH, heavy-hex carbon-steel nuts or equal per ASTM A490-10 Section 3.2; and ASTM F436, Type 1, hardened carbon-steel washers with plain finish. ASTM F2280 Twist-Off Type Torque Control Bolts are a suitable alternative to ASTM A490 bolts.
 3. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.
 - a. Finish: Hot-dip zinc coating.
 - b. Zinc-Coated ASTM F1852 Twist-Off Type Torque Control Bolts are a suitable alternative to ASTM A325 bolts.
 4. Unfinished Bolts and Nuts (Machine Bolts) and Threaded Rods: ASTM A307, Grade A, low carbon steel bolts and nuts; ASTM F436, Type 1, hardened carbon-steel washers.
 5. Shear Studs: ASTM A108, Grades 1015 or 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B and conform to requirements of AWS D1.1 Section 7.
 - a. Tensile strength, 60,000 psi.
 - b. Elongation in 2 inches, 20 percent
 - c. Reduction of area, 50 percent.
 6. Unheaded Anchor Rods: ASTM F1554 Grade 36, Grade 55 (weldable per S1 Supplementary Requirements), or Grade 105, where noted on drawings.
 - a. Configuration: Straight
 - b. Nuts: ASTM A563 heavy-hex carbon steel.
 - c. Plate Washers: ASTM A572 Grade 50 carbon steel.
 - d. Washers: ASTM F436, Type 1, hardened carbon steel.
 - e. Finish: Plain or Hot-dip zinc coating, ASTM A153, Class C.
 7. Headed Anchor Rods: ASTM F1554 Grade 36, ASTM F1554 Grade 55, weldable where notes on drawings, or ASTM F1554 Grade 105.
 - a. Nuts: ASTM A563 heavy-hex carbon steel.
 - b. Plate Washers: ASTM A572 Grade 50 carbon steel.
 - c. Washers: ASTM F436, Type 1, hardened carbon steel.
 - d. Finish: Plain or Hot-dip zinc coating, ASTM A153, Class C.
 8. Threaded Rods: ASTM A36 or A572, Grade 50.
 - a. Nuts: ASTM A563 heavy-hex carbon steel.
 - b. Plate Washers: ASTM A572 Grade 50 carbon steel.
 - c. Washers: ASTM F436, Type 1, hardened carbon steel.
 - d. Finish: Plain or Hot-dip zinc coating, ASTM A153, Class C.
 9. Williams 150 KSI All-Thread-Bars.
 - a. Nuts: ASTM A29 or A576 hex.
 - b. Plate Washers: ASTM A572 Grade 50 carbon steel.
 - c. Washers: ASTM F436, Type 1, hardened carbon steel.
 - d. Finish: Plain or Hot-dip zinc coating, ASTM A153, Class C.
 - e. Williams 150 ksi All-Thread-Bar is not to be subjected to the heat of a torch, welding or used as a ground.
 10. Tie Rods: ASTM A36 or A572, Grade 50.
 - a. Nuts: ASTM A563 heavy-hex carbon steel.
 - b. Washers: ASTM F436, Type 1, hardened carbon steel.
 - c. Finish: Plain or Hot-dip zinc coating, ASTM A153, Class C
 11. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A108, Grade 1035. Dimensions and minimum capacities to conform to the values listed in AISC "Steel Construction Manual".
 12. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A108, Grade 1030.

13. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A108, Grade 1018. Minimum proof load of sleeve nuts shall be such that when loaded axially the sleeve nut shall be stronger than the ultimate capacity of the connected parts.
 14. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following manufacturers:
 - 1) Amscot Structural Products Corp.
 - 2) Fluorocarbon Company Limited.
 - 3) R.J. Watson Bridge & Structural Engineered Systems.
 - 4) Seismic Energy Products, L.P.
 - b. Mating Surfaces: to be specified.
 - c. Coefficient of Friction: to be specified.
 - d. Design Load: to be specified.
 - e. Total Movement Capability: to be specified.
- G. Primer
1. Comply with Division 09.
 2. Primers and paints shall meet all federal and state environmental and air quality requirements.
 3. Primer Paint shall comply with all applicable SSPC requirements and shall be compatible with finish paints and spray-on fireproofing specified elsewhere.
 4. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 per ASTM A780.
 5. Primer:
 - a. Typical Interior Primer: SSPC-Paint 25, Type II or SSPC-Paint 23. Primer shall comply with the requirements called out in the "Green Seal Standard for Anti-Corrosive Paints" (GC-03).
 - b. Typical Exterior Primer: SSPC-Paint 20, Type II, Organic.
- H. Non-Shrink Cementitious Grout
1. Grout shall have a minimum 3,000 psi compressive strength at 48 hours and 7,000 psi compressive strength at 28 days.
 2. Metallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
 3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
 4. See Section 03 30 00 for acceptable products and additional requirements.

2.02 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303 and AISC 360.
1. Camber structural-steel members where indicated. Fabricate beams and girders with natural camber upward, unless noted otherwise on the drawings.
 2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel according to ASTM A6 and maintain markings until structural steel has been shop erected.
 4. Mark and match-mark materials for field assembly. Members shall be fabricated for delivery in a sequence that will expedite erection and minimize field handling of structural steel.
 5. Splice members only where indicated on Structural Drawings or where accepted by the Structural Engineer.

6. All hollow members exposed to weather shall be sealed with continuous welds, incorporating structural welds where shown or required, or provide weep holes where water may accumulate.
 7. Grind burrs, sharp arises and ragged edges that would prevent solid seating of the connected parts.
 8. AISC Group 4 and 5 shapes and built up members shall meet the requirements for joints in AISC Sections J1.5, J1.6, J2.7 and M2.2.
 9. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Holes and attachments to structural steel in areas designated as the Protected Zone are not allowed except as explicitly shown or noted on structural drawings.
- C. Tolerances: Except as noted as follows, maintain fabrication tolerances of structural steel within the tolerances specified on the drawings and AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible. An unguided torch may be used provided the cut is within 1/8 inch of the required line.
1. Plane thermally cut edges to comply with requirements in AWS D1.1.
- E. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
1. Use standard holes unless otherwise indicated on the Drawings. Holes shall be drilled or punched at right angles to the surface of the metal. Making or enlarging holes by burning is prohibited.
 2. Flame cut holes for fasteners are not acceptable.
 3. Holes in column baseplates shall be within the limits of Table 14.2 of AISC "Steel Construction Manual".
- F. Bending Steel Plate:
1. Bend plates perpendicular to the rolling direction.
 2. Grind flame cut plate edges transverse to the bend line.
 3. Grind out nicks in plate edges transverse to the bend line.
 4. Round sharp corners on plate edges transverse to the bend line.
 5. Bent plate deck edge closure may be excluded from Items 1-4 above.
- G. Heat Straightening: Will be permissible by the use of properly controlled heat, skilled personnel, proper equipment and in accordance with documents prepared by the fabricator and accepted. Reject materials that contain kinks or sharp angles. Material straightened prior to fabrication shall be rejected where it shows signs of distress or defects.
- H. Planing and Milling:
1. Bearing surfaces of columns and base plates shall be finished and constructed in accordance with AISC 360 Section M2.6, M2.8 and M4.4.
 2. Bearing surfaces of column end cuts shall meet a surface roughness of 500 micro inches or better.
- I. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning" or SSPC-SP 2, "Hand Tool Cleaning or SSPC-SP 3, "Power Tool Cleaning."
- J. End-Welded Studs:
1. Automatic end-welded studs: Automatically end-weld in accordance with the manufacturer's recommendations in such a manner as to provide complete fusion between the end of the stud and the plates. There shall be no porosity or evidence of lack of fusion between the welded end of the stud and the plate. The stud shall decrease in length during welding approximately 1/8 inch for 5/8 inch, and 3/16 inch for 3/4 inch diameter. Stud sizes indicated on drawings represent the finish stud height.
 2. Fillet-end welded studs: Studs may be welded using prequalified FCAW, GMAW, or SMAW processes provided the requirements of the AWS D1.1 Chapter 7 Section 7.5.5 are met as well as any other pertinent requirements of D1.1.

- K. Bolt Holes and Holes for Other Work: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
 - 1. Provide holes, slots and openings together with necessary reinforcing as shown on the Drawings required for securing work of other trades to the work specified here. Where openings are shown on the Drawings no change shall be permitted without prior approval. Openings shall be done in the shop.
 - 2. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
 - 4. Unless noted otherwise, make holes 1/16 inches larger than the nominal bolt diameter.
- L. The Contractor shall cooperate fully with requests from inspection and testing personnel for access to the connections and joints to be inspected and tested. This includes beam and column turning in shop, weld backing removal when nondestructive examination indicates rejectable conditions, and access to platforms or scaffolding as required to perform the work safely.
- M. Any technique not covered by this section shall be submitted to the SEOR for approval.

2.03

SOURCE QUALITY CONTROL

- A. Testing Agency: Testing Agency to perform shop tests and inspections as defined by AWS, AISC and these specifications. Testing Agency shall summarize their finding in inspection and testing reports. Reports shall identify any findings that are not in compliance with requirements of the project specifications.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. See Part 1 of this specification for additional testing and inspection requirements. As a minimum the inspector will make all tests and inspections as required by the Special Inspection provisions of the governing building code. Testing Agency will make all the tests and inspections indicated in the Contract Documents.
- C. Contractor shall correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
 - 1. Owner's Representative reserves right, at any time before final acceptance, to reject material not complying with requirements.
 - 2. Any tests that may be necessary to reconfirm any noncompliance of original work, and as may be necessary to show compliance of corrected work, shall be at Contractor's expense.
- D. Each person installing connections shall be assigned an identifying symbol or mark and all shop and field connections shall be so identified so that the Inspector can refer back to the person making the connection.
- E. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
 - 1. High Strength Bolted Connections: Furnish certified test reports for each lot of bolts in accordance with Section 9 of ASTM A325 and A490. Install bolts under the supervision of a qualified inspector in accordance with Section 9, Research Council "Specifications for Structural Joints using ASTM A325 or A490 Bolts". High strength bolts specified as Snug-Tight (ST) need not be inspected for bolt tension. For high strength bolts specified as Slip-Critical (SC), verify that 10% or a minimum of 2 bolts per connection are tensioned in accordance with the RCSC Specification.
 - 2. If high strength bolting inspection is indicated on the structural drawings or required by the applicable referenced standards, the testing laboratory shall provide inspection in accordance with AISC 360 Section N.
 - 3. High Strength Bolted Connections in the Seismic Force Resisting System will, in addition, comply with the required inspection in AISC 341 Section J.

4. Tension Calibrator: A tension measuring device shall be required at all job sites where bolts in slip-critical joints are being installed and tightened. The tension measuring device shall be used to confirm: (1) the suitability to satisfy the requirements of AISC for the complete fastener assembly, including lubrication if required to be used in the work, (2) calibration of wrenches, if applicable, and (3) the understanding and proper use by the bolting crew of the method to be used. The frequency of confirmation testing, the number of tests to be performed and the test procedure shall be as specified in 1.d. below, as applicable. The accuracy of the tension measuring device shall be confirmed through calibration by an approved testing agency at least annually.
5. Direct Tension Indicators: Observe all Direct Tension Indicators to see if proper tightness was achieved.
6. Joint Assembly and Tightening of Shear/Bearing Connections: Bolts in connections not within the slip-critical category shall be installed in properly aligned holes, but need only be tightened to the snug tight condition. The snug tight condition is defined as the tightness that exists when all plies in a joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. If a slotted hole occurs in an outer ply, a flat hardened washer or common plate washer shall be installed over the slot.
7. Joint Assembly and Tightening of Connections Requiring Full Pre-tensioning. Slip-critical connections shall be installed in properly aligned holes and tightened by one of the following methods.
 - a. Turn-of-nut Tightening: When turn-of-nut tightening is used, hardened washers are not required except as specified in the AISC. A representative sample of not less than three bolts and nuts of each diameter, length and grade to be used in the work shall be checked at the start of work in a device capable of indicating bolt tension. The test shall demonstrate that the method of estimating the snug-tight condition and controlling turns from snug tight to be used by the bolting crews develops a tension not less than five percent greater than the tension required for slip-critical connections.
 - b. Installation of Alternate Design Bolts: A representative sample of not less than three bolts of each diameter, length and grade shall be checked at the job site in a device capable of indicating bolt tension. The test assembly shall include flat hardened washers, if required in the actual connection, arranged as in the actual connections to be tensioned. The calibration test shall demonstrate that each bolt develops a tension not less than five percent greater than the tension required by AISC. Manufacturer's installation procedure shall be followed for installation of bolts in the calibration device and in all connections. When alternate design features of the fasteners involve an irreversible mechanism such as yield or twist-off of an element, bolts shall be installed in all holes of the connection and initially brought to a snug tight condition. All fasteners shall then be tightened, progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize relaxation of previously tightened fasteners prior to final twist-off or yielding of the control or indicator element of the individual fasteners. In some cases, proper tensioning of the bolts may require more than a single cycle of systematic tightening.
8. Mark bolts that have been completely tightened with an identifying symbol.
9. Standard Bolted Connections: Testing Agency shall inspect the installation of A307 bolts to verify that 10% of all bolts or a minimum of 2 bolts per connection are installed properly and tightened to a Snug-Tight (ST) condition.
- F. Welded Connections:
 1. Testing Agency shall be present during welding operations as necessary to perform required testing and inspections.
 2. Welding equipment: Welding equipment to be used in each case shall be acceptable to welding inspector. Use equipment with suitable devices to regulate speed, and manually adjust operating amperage and voltage. The amperage capacity shall be sufficient to overcome line drop, and to give adequate welding heat.

3. Welded Joint Details as Part of the SFRS:
 - a. Weld in accordance with AWS D1.8.
 - b. Weld Backing: The use of weld backing shall be in accordance with AWS D1.1. Weld backing shall be removed where required by the Contract Documents or for the WPS by AWS D1.1.
 - 1) Connections of the SFRS in which backing is not removed: backing shall be attached to the member or plate that does not have its surface prepared for the groove weld. Attachment shall be by either a 5/16" fillet or 3/16" groove weld along the complete bar length on the side of the bar opposite the groove weld.
 - 2) Beam-Column Connection Joints Requiring Removal of Weld Backing: Conform with AWS D1.8. Perform MT on the fillet weld and the immediately adjacent area.
4. Visual Inspection of Welding: Testing Agency shall visually inspect shop and field welding of structural steel in accordance with the governing building code and AWS D1.1. Visual inspection of welds shall include but not be limited to the following:
 - a. Verify: Welding Procedure Specification (WPS) sheet has been provided and has been reviewed with each welder making the weld, welder qualification and identification, fit-up meets tolerances of WPS and mark joint prior to welding, welding consumables are per the Contract Documents and the WPS, amperage and voltage at the arc with hand-held meters, meters on welding equipment are functioning and accurate.
 - b. Observe preheat and interpass temperatures, weld pass sequence and size of weld bead.
 - c. Multi-pass shop and field welds shall be inspected as required per the governing building code, AWS D1.1, AWS D1.8, AISC 360 Table N5.4 and AISC 341 Table J6.
 - d. Visually inspect welds of heavy structural sections, or plates of 1-1/2 inch minimum thickness, as follows:
 - 1) Columns – visually inspect first two (2) production columns 48 or more hours after completion of welding. If columns successfully pass inspection, no additional 48 hour delayed visual inspections are required.
 - 2) Plate Girders – visually inspect all plate girders 48 or more hours after completion of welding for presence of cracks.
 - e. Visually inspect areas where backing bars and welds tabs are removed for conformance with the surface roughness criteria of the specifications.
 - f. Verify that the effective throat thickness of flare groove welds is consistently obtained when flush to bar or section. This verification shall be based on test sections where necessary.
5. Nondestructive Testing Requirements: Testing Agency shall perform non-destructive testing of shop and field welding in accordance with the project specifications, governing building code, and AWS D1.1. Extent of non-destructive testing shall be as follows:
 - a. Complete Joint Penetration (CJP) welds: UT 100% CJP welds greater than 5/16-inch. MT 25% all DCW CJP welds. MT 100% of all DCW CJP weld ends.
 - b. Partial Joint Penetration (PJP) welds: UT 100% of PJP welds greater than 5/16-inch. UT 100% PJP in column splices.
 - c. Column Web Material at Continuity Plate: MT the WF column webs 3-inches above and below the weld terminations at the first 50 continuity plates and doubler plates installed. Test shall be conducted when weld has cooled to ambient temperature. If no web cracks are found, then no more testing required. This test shall also be conducted for all locations where the Contractor has welded into the "no weld" zone shown on the Drawings for continuity plates.
 - d. Access holes at splices in Heavy Structural Sections – MT or PT 100%.
6. Special non-destructive testing for welds in the Seismic Force Resisting System shall have additional testing per AISC Seismic Provisions, AWS D1.8 and the governing building code, and as follows:

- a. Backing Bars Removed - MT 20% of the locations where the backing bars and weld tabs are removed after the roughness criterion is attained.
 - b. Reinforcing Fillet Weld placed where backup bars are removed - MT 100% of the welds.
 - c. Access holes and copes in SMRF beams – MT or PT 100%.
 - d. Heavy Structural Section flanges and/or plate thicker than 1-1/2 inches where subject to through-thickness weld shrinkage strains (including column flanges and base plates) – UT flange or plate material for lamellar discontinuities 3" to each side of CJP weld prior to CJP weld (this includes base plates). If rejectable defects are found then beam shall not be welded to the flange or plate at this location. This test should be conducted in the shop. In addition, UT material after weld for discontinuities behind and adjacent to such welds. The test procedure and acceptance criteria shall be per ASTM A898 Level I or ASTM A435.
 - e. Fillet Welds: Fillet welds of gusset plates to beams, columns and base plates - MT 10% of the following fillet welds and reduce to 5% if no significant cracks are found in the first 50 tested:
 - a) gusset plate fillet welds to beam and columns; b) base plate fillet welds.
7. All full penetration groove welds will be subject to ultrasonic testing, as per AWS D1.1, Clause 6 "Inspection, Part "F", Ultrasonic Testing (UT) of Groove Welds. All defective welds shall be repaired and retested with ultrasonic equipment at the Contractor's expense.
 8. Box columns and built-up members shall have ultrasonic testing before and after welding.
 9. Column Flanges: An area extending 6 inches above and below point where girder flanges are attached will be inspected. Column flange edges will be inspected visually and entire area ultrasonically for lamination, plate discontinuities, and non-metallic inclusions.
 10. When ultrasonic indications arising from the weld root can be interpreted as either a weld defect or the backing strip itself, the Engineer will be notified. The Engineer may require the removal of backing strip. The backing strip will be removed at the expense of the Contractor, and if no root defect is visible the weld will be retested. If no defect is indicated on this retest, and no significant amount of base and weld metal have been removed, no further repair of welding is necessary. If a defect is indicated, it will be repaired and retested at Contractor's expense.
 11. The ultrasonic instrumentation will be calibrated by the technician to evaluate the quality of the welds in accordance with AWS D1.1.
 12. Other methods of inspection, for example, X-Ray, gamma ray, magnetic particle, or dye penetrant, may be used on welds if felt necessary by the inspection laboratory, and with the approval of the Engineer.
 13. Base metal thicker than 1-1/2 inches, when subjected to through thickness weld shrinkage strains, shall be ultrasonically inspected for discontinuities directly behind such weld before and after joint completion.
 14. At the discretion of the owner's testing agency, except for Demand Critical Welds as per AISC 341 Section J6.2g, the ultrasonic testing frequency may be reduced but may not be less than the following:
 - a. Initially, all welds requiring ultrasonic testing will be tested at the rate of 100 percent in order to establish the qualifications of each individual welder. If the reject rate is demonstrated to be less than 5 percent of the welds tested for each welder, then the frequency of testing for that welder may be reduced to 25 percent. If the reject rate increases to 5 percent or more, 100 percent testing will be re-established until the rate is reduced to less than 5 percent. The percentage of rejects will be calculated for each welder independently.
 - b. A sampling of a least 40 completed welds will be made for such reduction evaluation. Reject rate is defined as the number of welds containing rejectable defects divided by the number of welds completed. For evaluating the reject rate of continuous welds over 3 ft in length where the effective throat is 1" or less, each 12 inch increment or fraction thereof shall be considered as one weld. For evaluating the reject rate of

continuous welds over 3 ft in length where the effective throat is greater than 1", each 6 inch of length or fraction thereof shall be considered one weld.

- G. In addition to visual inspection, shop-welded shear studs will be tested and inspected according to requirements in AWS D1.1 and the governing building code for stud welding and as follows:
 - 1. The type and capacity of the welding equipment shall be in accordance with the manufacturer's recommendations and shall be checked and approved.
 - 2. At the beginning of each day's work, a minimum of 2 test stud welds shall be made, with the equipment to be used, to metal which is the same as the actual work piece. The test studs shall be subjected to a 90-degree bend test by striking them with a heavy hammer. After the above test, the weld section shall not exhibit any tearing or cracking.
 - 3. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 4. Tests will be conducted on additional shear studs if weld fracture occurs on shear studs already tested, according to requirements in AWS D1.1.
- H. Inspection Records
 - 1. The inspector will maintain a daily record of the work that has been inspected and its disposition. One copy of each report will be submitted to the Owner on a weekly basis. Test reports will be made on the form suggested in the AWS D1.1 "Structural Welding Code".
 - 2. Make systematic record of all shop welds, including:
 - a. Date of inspection.
 - b. Location and type of weld.
 - c. Identification marks of welders.
 - d. List of defective welds.
 - e. Manner of correction of defects.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify, with steel Erector present, locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Discrepancies: In the event of discrepancy, immediately notify the Owner's Representative in writing. Do not proceed with construction in the region of the discrepancy until all such discrepancies have been resolved.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. The Contract Drawings indicate the completed structure. The Contractor is fully responsible for all temporary measures necessary for erection, except where specific sequences and requirements are specified on the Drawings.
 - 2. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.
- B. Furnish templates for exact locations of items to be embedded in concrete and any setting instructions required for installation.

3.03 CONNECTIONS

- A. General Bolting:
 - 1. Product containers must be marked with lot numbers and traceability information so that correspondence with mill reports can be established. Manufacturer's symbol and grade markings shall appear on all bolts, nuts, through-hardened washers and direct tension indicators.
 - 2. Bolts shall be of a length that will extend to a point at least flush with the surface of the nuts, though not more than a length equal to the height of the nut, beyond the nuts unless otherwise noted.
 - 3. Bolts shall be installed with threads excluded from the shear plane.
 - 4. Washers shall be used on all bolts. Use beveled washers where bolts bear on sloping surface.
- B. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts" for type of bolt and type of joint specified. Contact surfaces of bolted parts shall as a minimum comply with the Class A requirements.
 - 1. Joint Type shall be as noted on drawings.
 - 2. Direct tension indicator (load indicating washers or "Tension-Set" bolts) method shall be used at slip-critical connections. "Turn-of-Nut" methods are not an acceptable alternative.
 - 3. When connection has bolts and welds, fully tighten bolts prior to welding with the exception that in moment connections the flange welds shall be completed prior to final tightening of high strength bolts.
 - 4. When already tensioned bolts have had their tension relaxed, replace the bolt and tension indicator and re-tighten.
- C. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work. Quality of materials and design and fabrication of all welded connections shall conform to AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Building," "AWS Code for Welding in Building Construction," and requirements of this section.
 - 1. Location and type of all welds shall be as shown. Make no other welded splices, except those shown on drawings, without prior approval of the Structural Engineer.
 - 2. Automatic Welding: Use electrode wire and flux for automatic and semi-automatic welding acceptable to Structural Engineer. All methods, sequences, qualification and procedures, including preheating, and post heating if necessary, shall be detailed in writing and submitted to the Structural Engineer for review.
 - 3. Preparation of surface: Surfaces to be welded shall be free of loose scale, slag, rust, grease, paint, and any other foreign material.
 - 4. Shop welds shall be inspected in the shop before the work is painted or shipped.
 - 5. Control cooling process after weld is completed by either step down post heat or thermal blankets as determined by procedures and prequalification.
 - 6. Weld sizes where shown shall be assumed to be effective weld sizes.
 - 7. All groove or butt welds shall be full penetration unless noted otherwise on the Drawings.
 - 8. Where structural steel members are to remain exposed in the finished work, welds exposed to view shall be uniformly made and ground smooth.
 - 9. Remove runoff tabs and grind surfaces smooth where the tabs would interfere with architectural finishes.
 - 10. Weld tabs shall be in accordance with AWS D1.1. In addition, weld tabs shall extend beyond the edge of the joint a distance not less than 1-inch except at access holes in beam/girder webs and at continuity plate clips. Weld tabs shall be oriented parallel to the joint preparation and to the weld direction. Weld dams are not allowed.
 - 11. Remove weld tabs and backup plates and grind surfaces smooth as required for inspection or testing. Where tabs or backup bars interfere with architectural treatment or are exposed to view in the final structure, remove and grind smooth.

12. Splices of members in tension, all members of moment frames and all members of braced frames that are made from heavy steel sections shall be made in conformance with Section J1.5 of AISC 360.
13. Weld variables shall be consistent with the recommendations of the electrode manufacturer.
14. Do not weld into column flange-to-web intersection as defined the AISC “k” and “k1” distances except for the doubler plate to column welds. Continuity plate welds shall stay clear of this area as noted on the drawings.
15. Sequence the work as necessary to accommodate testing.
16. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.
17. Welding Procedures:
 - a. Weld only in accordance with the Welding Procedure Specifications. WPS shall be readily available to all welders, inspectors, and supervisors during the production process.
 - b. Consider toughness and notch sensitivity of steel in formation of the welding procedures to prevent brittle and premature fracture during fabrication and erection. Toughness requirements are to match those of the parent metal.
 - c. Weld in a manner to minimize accumulation and concentration of through-thickness strains due to weld shrinkage. Sequence welds in a manner to reduce residual stresses (caused by welding) to a minimum value. Welding procedures shall incorporate measures necessary to eliminate cracking.
 - d. Do not mix different electrodes in the same weld joint unless the interactions have been shown not to cause problems.
 - e. Stringer passes only, no weaving or wash passes. Manipulation of the electrode for vertical welds (oscillation) shall be kept to a maximum movement of 4 to 5 electrode diameters.
 - f. Welding shall not begin until joint elements are bolted or tacked in intimate contact and adjusted to dimensions shown in the Drawings, with proper allowance for any weld shrinkage.
 - g. All tack welds shall be of the same quality as final welds. Tack welds within Demand Critical welds at Seismic Force Resisting System members shall be per AWS D1.8; all other tack welds shall be per AWS D1.1.
18. Additional Welding Requirements:
 - a. Weld Access Holes shall be in accordance with AISC Specification J1.6 and AWS D1.1 except as otherwise noted in the Construction Documents. The access hole shall be ground smooth to a surface roughness not to exceed 500 micro-inches, and shall be free of notches and gouges. For this purpose, a notch of gouge is any depression deeper than the overall surface roughness.
 - b. Pay increased attention to uniform and adequate preheat.
 - c. Maximum interpass temperature not to exceed 550 degrees F when notch toughness properties are specified.
 - d. Complete individual weld layers prior to applying portions of subsequent layers. Ends of interrupted passes to be staggered. Minimize starts and stops within body of the weld.
 - e. Where required by specifications and/or contract drawings, remove backing bars and apply reinforcing fillet weld per note J of figure 3.4 of AWS D1.1 and AWS D1.8 section 6.7 and 6.8. Remove backing bar with air carbon arc cutting, grinding, chipping or thermal cutting. The process shall be controlled to minimize gouging and removal of base metal except for material immediately adjacent to the weld. After removal of backing the root shall be backwelded with a reinforcing fillet weld with a minimum leg of 5/16-inch.
 - f. At continuity plate to column welds, the backing bars do not need to be removed.
 - g. At Demand Critical Welds: Cut off weld tabs 1/8-inch (1/4-inch at continuity plates) from the edge and grind to a surface roughness of 500 micro-inches or better.

- h. Where bottom cover plates are acting as back-up plates, welds in the vicinity of the web cope area shall be carefully checked by ultrasonic inspection. Any indication of weld discontinuities shall be cause to remove suspect portions of welds by cut-outs. The cut-out areas shall be ground smooth to sound bright metal for visual inspection. If visual inspection is inconclusive or questionable, verify by magnetic particle testing. If weld defects, slag inclusions, etc. are present, remove them by air arcing and clean up by grinding. Repair welds and add a reinforcing fillet weld at least 1/4 of the bottom flange thickness but need not be greater than 5/16 inch. If there are no defects, clean up by grinding and reinforce with fillet weld. Ultrasonic testing (UT) inspection shall be conducted from both sides of the flange to ensure sound welds.
- i. Flame cut surfaces at weld access holes within heavy sections shall be ground per AISC 360 Section M2.2.

D. Refer to the Structural Drawings for additional requirements.

3.04 SHOP PRIMING

- A. Shop prime all steel surfaces which, in the final constructed condition, are exposed to weather or not completely concealed by building finishes unless noted otherwise and excepting the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded and areas within 4 inches on each side of field welds.
 - 3. Top surfaces of beams to receive welded metal deck.
 - 4. Contact surfaces to be slip-critical high-strength bolted. Areas exposed to the weather shall receive a Class A primer coat compatible with slip-critical type connections.
 - 5. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 6. Galvanized surfaces.
 - 7. Machined surfaces.
 - 8. Welded shear studs.
 - 9. Where enclosed within the building envelope and is protected from exterior exposure.
- B. Steel members not otherwise painted shall be painted when subjected to condensation from piping, are in shower or steam rooms, are exposed to chemical fumes or are exposed to other conditions of potentially aggressive corrosion
- C. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the applicable SSPC specification requirements for each primer. As a minimum, all surfaces shall be prepared according to the following specifications and standards:
 - 1. SSPC-SP1 "Solvent Cleaning"
 - 2. SSPC-SP 2, "Hand Tool Cleaning"
 - 3. SSPC-SP3, "Power Tool Cleaning"
 - 4. Where jobsite exposure is expected to exceed 6 months, SSPC-SP6 Commercial Blast Cleaning is required.
- D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness as recommended by manufacturer. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Material: Type A Themec Company, Inc., Series V10; Sherwin Williams Steel Spec Universal; Metal Case 94-231 Series or approved equal.
 - 2. Number of Coats: One.
 - 3. Volume Solids: 56.0 +/- 2.0% minimum.
 - 4. Generic Description: Modified Alkyd.
 - 5. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 6. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

- E. Unless noted otherwise in subsection G, use the following Type B shop painting systems on all exterior steelwork and interior steelwork subjected to wet conditions or fumes (see subsection G for additional requirements)
 - 1. Surface Preparation: SSPC-SP6 Commercial Blast Cleaning
 - 2. Application: Follow coating manufacturer's printed directions.
 - 3. Material: Type B Tnemec 90-97 Tneme-Zinc primer or approved equal
 - 4. Number of Coats: One
 - 5. Dry Film Thickness: 2.5 to 3.5 mils
 - 6. Volume Solids: 63% +/- 2%
 - 7. Generic Description: Zinc-Rich Urethane
- F. Unless noted otherwise in subsection G, use the following finish painting systems on all exterior steelwork and interior steel work subjected to wet conditions or fumes (see subsection G for additional requirements):
 - 1. Application: Follow coating manufacturer's printed directions. Apply over Type B primer system above.
 - 2. Material: Tnemec Series 750 UVX paint or approved equal
 - 3. Number of Coats: One
 - 4. Dry Film Thickness: 2.5 to 5 mils
 - 5. Volume Solids: 72% +/- 2%
 - 6. Generic Description: Polyfunctional Hybrid Polyurethane
- G. All exterior steelwork and all interior steelwork subjected to wet conditions or fumes, including all welds, bolts, washers and other connection components, shall be primed and painted or hot-dip galvanized, as specified by the Architectural finish specifications. In the absence of Architectural finish specifications, all exterior steelwork and all interior steelwork subjected to wet conditions and fumes, including all welds, bolts, washers and other connection components, shall be hot-dip galvanized, conforming to the requirements set forth in ASTM A123 and ASTM A153.
- H. All steel exposed to weather in the final structure shall be galvanized or painted.
- I. Use special care if steel is fabricated, cleaned, and painted in damp weather to remove moisture from mill scale cracks.
- J. Clean contact surfaces of high strength bolts of all burrs and material which might prevent solid seating of the parts. Steel to receive bolts shall be primer painted except beneath the contact area of slip-critical bolts.

3.05 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123 and to bolts, nuts, and washers according to ASTM A153. Galvanize all items noted on Drawings to be galvanized and fasteners that connect galvanized components, except that ASTM A490 bolts shall not be hot-dip galvanized. Where ASTM A490 bolts connect galvanized components, use A490 Type 3 bolts.
 - 1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with engine freeze/core plugs installed per manufacturer's recommendations.
 - 2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.
 - 3. Roughen faying surfaces of slip-critical high-strength bolted connections to achieve Class C surface accordance with the RCSC Specifications.

3.06 ERECTION

- A. Structural steel erection: Comply with AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Building", latest edition.
- B. Erection Sequence: Erect steel in accordance with special erection sequences where special erection sequences are indicated on the contract documents.

- C. Mark each member with erection identification corresponding to mark shown on erection drawings. Carefully plan erection of structural steel so that no cutting and removal of material will be necessary. Do not torch burn in the field, unless specifically permitted by Engineer.
- D. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360. Check plumbness after erection of each tier.
- E. Dimensions shown on drawings are based on an assumed design temperature of 70 degree Fahrenheit. Fabrication and erection procedures shall take into account the ambient temperature range at the time of the respective operations.
- F. Care shall be taken to protect work already installed from damages resulting from structural steel erection.
- G. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates. Remove any templates used for the setting of anchor bolts.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate at locations that are specified per the structural design details.
 - 3. Snug-tighten or Pretension anchor rods after supported members have been positioned and plumbed. If used, do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Grout solid under plates with a flowable non-shrink grout per Section 03 30 00 prior to placement of concrete fill over metal deck at any floor level. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- H. Maintain erection tolerances of structural steel within AISC 303.
- I. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
 - 3. Shimming or other adjustments not indicated on drawings shall be approved by the Engineer prior to installation. Column shimming shall be ¼ inch.
- J. All welds shall be full and clean, and conform to AISC and AWS specifications.
- K. Splice members only where indicated.
- L. Do not use thermal cutting during erection unless approved by SEOR. Finish thermally cut sections within smoothness limits in AWS D1.1.
- M. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts. Where a hole is required to be enlarged by more than 3/32-inch ream to and use next larger bolt size.
- N. Shear Studs: Prepare steel surfaces as recommended by manufacturer of shear studs. Use automatic end welding of headed-stud shear studs according to AWS D1.1 and manufacturer's written instructions.
- O. Temporary Shoring and Bracing:
 - 1. The Contract Drawings indicate the completed structure. The Contractor is fully responsible for all temporary measures necessary for erection, except where specific sequences and requirements are specified on the Drawings. See the Drawings for erection sequence notes and minimum requirements.
 - 2. Contractor is responsible for identifying need for temporary construction and for the design, installation and use of all temporary bracing and supports necessary to stabilize the framing until the structure is complete as indicated on the Contract Documents.

Completed structure includes the complete structural steel framing system, metal deck with complete connections and interconnections, concrete fill where occurs, other non-steel stabilizing structural systems interconnected to the structural steel frame where applicable, e.g. shear walls, grade beams, tie beams, collector beams, etc.

3. Provide temporary works as necessary to erect the structure and achieve proper alignment as erection proceeds. In addition, provide temporary bracing and shoring to brace the incomplete structure against loads such as wind and seismic forces comparable in intensity to the design loads for the completed structure.
4. Make all necessary provisions for temporary bracing and for completion of erection where structural members are temporarily left out for erection at a later time.
5. Temporary bracing shall not impose lateral loads on column anchor bolts unless approved by the SEOR. Contractor shall provide adequate means of column restraint to resolve bracing lateral loads.

P. Temporary Flooring:

1. Provide planking and scaffolding necessary in connection with erection of structural steel, support of erection machinery, and construction materials. Temporary floors and use of steel shall be as required by applicable regulatory requirements.
2. If steel decking is used as a working platform, it shall be temporarily tack-welded to supports to extent necessary for such use in accordance with applicable regulatory requirements. The concentrated loading from welding machines and other heavy machinery required for steel erection shall be distributed by planking or other approved means. Metal decking that becomes damaged as the result of being used as a working platform shall be replaced at no additional cost to the Owner.

Q. Hoisting and Bracing:

1. Provide all hoisting and erecting equipment and power.
2. Provide and maintain any and all safety railings, etc., required for the erection of steel framing and metal decking or as directed by the General Contractor.
3. Brace the erected frame in a manner which will assure safety and proper alignment to receive the metal decking in accordance with Contractor's approved erection procedure.
4. Erect building frame true and level. Erect columns in a manner to allow for movement due to welding shrinkage and thermal expansion and contraction of framing. Check plumbness after erection of each level. Maintain structural stability of frame during erection. Provide temporary bracing where necessary to maintain frame stability and to support required loads, including equipment and its operation.

R. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

S. Shop Drawings for temporary works located within the building envelope shall be submitted to the Engineer of Record for review and approval. Temporary works Shop Drawings shall show fabrication of structural-steel components, including details of layout and connections, fabrication of all members, and element and erection plans, and erection sequence. Shop Drawings shall identify temporary works members to remain in the permanent structure. Review of Shop Drawings by the Engineer of Record is of a general nature only.

3.07

FIELD CONNECTIONS

- A. Field connection requirements shall be as a minimum equal to those specified in Part 2 of this document.
- B. Erection bolts for welded connection shall be tightened securely and left in place, unless noted otherwise.
- C. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts" for type of bolt and type of joint specified.
- D. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or weld tabs where required by specifications or contract drawings, back gouge, and grind steel smooth.
 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.
 4. Weld in manner to prevent warping or distortion of finished product. Use jigs which will not restrain piece from moving during welding or cooling after welding. Sequence weld passes at a joint to prevent excessive heat build-up or cause shrinkage cracks to form.
 5. Auxiliary Member Connections and Temporary Welds shall be per AWS provided that preheating may be omitted on ASTM A36 steel for single pass fillet welds with low hydrogen electrodes under the following conditions: Air temperature is 60 degrees Fahrenheit or over, steel is dry, and welds to structural base material are more than 1" away from corners or ends of plates.
 6. Preheat and post-heat procedures for welded joints shall be utilized to prevent rapid cooling of welds, particularly in cold weather. Procedures are Contractor's responsibility.
- E. Shear Studs: The shear studs shall be automatically end welded in accordance with AWS D1.1 and the manufacturer's recommendations in such a manner as to provide complete fusion between the end of the stud and the plate.
1. There should be no porosity or evidence of lack of fusion between the welded end of the stud and the plate.
 2. Shear studs through metal deck shall be welded through the deck within 1 day of laying the deck.
- F. Bearing Pads: Install bearing pads in accordance with manufacturer's recommendations.

3.08

FIELD QUALITY CONTROL

- A. Field quality control shall, as a minimum, conform to the requirements specified under Source Quality Control in Part 2.
- B. Erection Tolerances: Unless otherwise noted, level and plumb individual members of the structure as per AISC 303 Section 7.13 'Erection Tolerances'. Make level and plumb based on the mean operating temperature of the structure, allowing for the difference in temperature at time of erection and the mean temperature of the structure when completed and in service. Base measurements relating to tolerances on the theoretical centerline of the columns.
1. Columns: Gaps exceeding 1/8 inch between milled ends not permitted. Shim acceptable gaps with non-tapered mild steel shim stock.
 2. In order to provide a true, flat plane for the exterior elevations, install perimeter steel deck edge closure such that the vertical face does not vary from its intended alignment more than +/- 3/4" at any location.
 3. All columns and beams shall adhere to Section M2.7 of the referenced "Specification for Structural Steel for Buildings" which states that completed members shall be free of twists, bends, and open joints. Take special care that column base plates are parallel and perpendicular to faces of columns and that bolt holes are accurately placed.
- C. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Verify structural-steel materials and inspect steel frame joint details.
 2. Verify weld materials and inspect welds.
 3. Verify connection materials and inspect high-strength bolted connections.
- D. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- E. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
1. The Inspector shall observe all Direct Tension Indicators to see if proper tightness is achieved.

- F. Welded Connections: Field welds will be visually inspected according to AWS D1.1, the governing building code, and Part 2 of this document, by the Testing Agency.
- G. Defective Work:
 - 1. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents. Work deemed defective will be removed from the site at the Contractor's expense.
 - 2. Any special tests not specifically covered by this specification that are proposed by the Contractor as a result of failure to comply with this Section shall be at the Contractor's expense. The Contractor shall be responsible for any consequential costs or delays.
 - 3. The results of those tests will be accepted, at the discretion of the Architect, as proof of adequate materials or workmanship.

3.09 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.
- D. Repair of Openings: For all members exposed to view in the final structure, close all lifting holes, access openings, etc. in such a manner that no visual evidence of the opening remains.

END OF SECTION

SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Formed steel stud interior wall and wall framing.
- B. Formed steel joist and purlin framing and bridging.

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 – Cast In Place Concrete.
- B. Section 05 12 00 – Structural Steel Framing.
- C. Section 06 10 00 - Rough Carpentry.

1.04 REFERENCE STANDARDS

- A. Utilize the edition of the listed document as identified in the “Design Criteria Notes” in the structural drawings. If not listed in the “Design Criteria Notes”, use the edition adopted or referenced by the listed governing building code or material standard. If no specific edition is adopted, use the latest edition.
 - 1. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members.
 - 2. AISI S202 – Code of Standard Practice for Cold-Formed Steel Framing.
 - 3. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing.
 - 4. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing.
 - 5. AISI S400 - North American Standard for Seismic Design of Cold-Formed Steel Structural Systems.
 - 6. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 8. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.
 - 9. ASTM A1011 - 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.
 - 10. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing.
 - 11. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
 - 12. AWS B2.1 - Specification for Welding Procedure and Performance Qualification.
 - 13. AWS D1.1 - Structural Welding Code - Steel.
 - 14. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
 - 15. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations, and accessories.
- C. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and conditions requiring special attention.
- E. Manufacturer's Qualification Statement.
- F. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1 and dated no more than 12 months before the start of scheduled welding work.
- G. SSMA Manufacturer Qualification: Submit documentation of manufacturer association membership.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.
- B. Manufacturer Qualifications:
 - 1. Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com.
 - 2. Member of Steel Framing Industry Association (SFIA): sfia.memberclicks.net.
- C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1 and AWS D1.3 and dated no more than 12 months before start of scheduled welding work.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.
- E. 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.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect metal framing units from rusting and damage.
- B. Deliver to Project site in manufacturer's unopened containers or bundles, identified with name, brand, type and grade.
- C. Store off ground in a dry ventilated space or protect with suitable waterproof covering.

1.09 PROJECT CONDITIONS

- A. Prior to Pre-installation Conference, review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Framing:
 - 1. CEMCO: www.cemcosteel.com.
 - 2. ClarkDietrich: www.clarkdietrich.com.
 - 3. SCAFCO Corporation: www.scafco.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Framing Connectors and Accessories:
 - 1. ClarkDietrich: www.clarkdietrich.com.
 - 2. Simpson Strong-Tie: www.strongtie.com.

3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FRAMING SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.
 - 1. Able to tolerate 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 ranges.
 - 2. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
- B. Shop fabricate framing system to the greatest extent possible.
- C. Deliver to project site in largest practical sections.
- D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.03 FRAMING MATERIALS

- A. Studs and Track: ASTM C955; studs formed to channel, C- or Sigma-shaped with punched web; U-shaped track in matching nominal width and compatible height.
 - 1. Gauge and Depth: As indicated on Drawings and as required to meet specified performance levels.
 - 2. Galvanized in accordance with ASTM A653, G60 coating.
 - 3. Products:
 - a. Comply with ICC ES 3064P or ICC ES 4205.
 - 1) CEMCO: www.cemcosteel.com
 - 2) SCAFCO Corporation: www.scafco.com
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.
- B. Framing Connectors: Factory-made, formed steel sheet.
 - 1. Material: ASTM A653 SS Grade 33 and 40 (minimum), with G90 hot dipped galvanized coating for base metal thickness less than 10 gauge, 0.1345 inch (3.42 mm), and factory punched holes and slots.
 - 2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100 and AISI S400 as required.
 - 3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
 - a. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
 - b. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.
 - c. Products:
 - 1) ClarkDietrich; Drift FastClip Slide Clip D-FCSC: www.clarkdietrich.com
 - 2) ClarkDietrich; FastClip Slide Clip FCSC: www.clarkdietrich.com
 - 3) Simpson Strong-Tie; SCB Side-Clip Connector: www.strongtie.com
 - 4) Substitutions: See Section 01 60 00 - Product Requirements.
 - 4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.
 - a. Products:
 - 1) Simpson Strong-Tie: www.strongtie.com

- 2) Substitutions: See Section 01 60 00 - Product Requirements.
5. Wall Stud Bridging Connections: Provide mechanical load-transferring devices that accommodate wind load torsion and weak axis buckling induced by axial compression loads. Provide bridging connections where indicated on the drawings.
6. Products:
 - a. ClarkDietrich; Spazzer 5400 Bridging Bar: www.clarkdietrich.com
 - b. ClarkDietrich; FastBridge Clip: www.clarkdietrich.com
 - c. Simpson Strong-Tie; SUBH Bridging Connector: www.strongtie.com
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 FASTENERS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Screws shall comply w/ ASTM C1513. Exterior applications shall be Type 316 Stainless Steel or Hot Dip Galvanized per ASTM A153, Class C.
 1. Products:
 - a. Grabber Construction Products Inc. per ESR 1271: www.grabberpro.com
 - b. Primesource Building Products per ESR 1408: www.primesourcebp.com
 - c. ITW Commercial Construction North America; ITW CCNA-Buildex Tek Select Series per ESR 1976 or 3223: www.ITWBuildex.com
 - d. Hilti per ESR 2196: www.hilti.com
 - e. Brighton Best International Inc. per ESR 3231: www.brightonbest.com
 - f. Elco Construction Products per ESR 3294: anchors.dewalt.com
 - g. Simpson Strong-Tie Company per ESR 3006: www.strongtie.com
 - h. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Anchorage Devices: As indicated on the Drawings.
- C. Welding: Comply with AWS D1.1.

2.05 ACCESSORIES

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components unless otherwise noted.
- B. Plates, Gussets, Clips: Formed Sheet Steel, thickness determined for conditions encountered; finish to match framing components unless otherwise noted.
- C. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify field measurements and adjust installation as required.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- 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 wall bottom track or rim track and the top of foundation wall or slab at stud locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

3.03 INSTALLATION OF FRAMING, GENERAL

- A. Install components in accordance with manufacturers' instructions and AISI S200 - Code of Standard Practice for Cold-Formed Steel Framing.
- B. Install cold-formed metal framing and accessories plumb, level, square, and true to line, and with connections securely fastened.
- C. Install framing members at 16-inches on center unless otherwise shown. Framing at sink and toilet carriers may be installed at 24 inches on center where the span rating for the attached sheathing can accommodate the increased spacing.
- D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.
- E. Align floor and ceiling tracks; locate to wall layout. Coordinate installation of sealant with floor and ceiling tracks.
- 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 and control joints with cold-formed metal framing. Independently frame both sides of joints.
- H. Install insulation, specified in Division 07 Section "Thermal 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 standard punched openings.
- J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable non-cumulative tolerance variation of 1/8 inch in 8 feet (1:768) and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
- K. Touch-up field welds and damaged galvanized surfaces with primer.

3.04 WALL FRAMING INSTALLATION

- A. Install movement joints at corners and intersections to allow for differential movement of wall planes.
- B. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as indicated.
 - 1. Fasten bottom track to concrete floor slab with power actuated fasteners or expansion anchors sized and spaced as shown on Drawings or as required by structural performance.
 - 2. Fasten top compensation channel to structure as indicated on the Drawings.
- C. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch 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 indicated.
- D. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar configurations.

- E. Align load bearing studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- F. Align floor and roof framing over load bearing studs. Where framing cannot be aligned, continuously reinforce track to transfer loads or as shown in approved engineering shop drawings.
- G. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as required.
- H. 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 as shown in approved engineered shop drawings.
 - 1. Frame wall openings with jamb studs per the schedule(s) on the Drawings at each jamb of frame. Fasten jamb members together to uniformly distribute loads as shown in approved engineered shop drawings.
 - 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 as shown in the drawings.
- I. 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.
 - 2. Provide backing plate support for each point of fastening of every unit to be anchored. Coordinate requirements and locations with work of related sections.
- J. Install horizontal bridging in stud system, spaced at (vertical distance) not more than four feet on center and as indicated; fasten at each stud intersection. Horizontal bridging may be omitted at interior wall framing where gypsum board sheathing is required on both sides for the full height of the wall.
 - 1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches deep.
- 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 as shown in the drawings.
- L. Install strap bracing and blocking at unsheathed sides of walls as indicated on the Drawings.

3.05 INSTALLATION OF JOISTS AND PURLINS

- A. Install framing components in accordance with manufacturer's instructions.
- B. Make provisions for erection stresses. Provide temporary alignment and bracing.
- C. Place joists with spacing as indicated on the Drawings; not more than 2 inches from abutting walls, and connect joists to supports using fastener method.
- D. Set floor and ceiling joists parallel and level, with lateral bracing and bridging.
- E. Locate joist end bearing directly over load-bearing studs or provide load distributing member to top of stud track.
- F. Provide web stiffeners at reaction points as required by the Drawings.
- G. Touch-up field welds and damaged galvanized surfaces with primer.

3.06 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 in accordance with Division 01.
- 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.

3.07 REPAIRS AND PROTECTION

- A. Painting Repairs: Use compatible primer for prime coated surfaces.
- B. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to manufacturer's written instructions.
- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensures that cold-formed metal framing is without damage or deterioration at time of Completion.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Shop fabricated steel and aluminum items.
- B. Slotted channel framing (Unistrut) as shown on Drawings.
- C. Steel framing and supports for:
 - 1. Operable partitions.
 - 2. Overhead doors.
 - 3. Overhead grilles.
 - 4. Countertops.
 - 5. Ceiling-hung toilet compartments.
 - 6. Steel tube supports for free-standing partitions.
 - 7. Metal bollards.
 - 8. Shelf angles.
 - 9. Steel weld plates and angles.
 - 10. Diamond plate metal threshold.
 - 11. Miscellaneous steel trim, including:
 - a. Steel angles for window pop-outs.
 - b. Steel edgings.
 - c. Loading-dock edge angles.
 - 12. Metal fabrications for window washing, including:
 - a. Mounting brackets.
 - b. Anchorages.
 - c. Steel framing and supports (outriggers).
 - 13. Safety Line Tiebacks.
 - 14. Metal fabrications for landscape planter walls.

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 05 12 00 - Structural Steel Framing.
- C. Division 09 – Painting Sections.

1.04 REFERENCE STANDARDS

- A. Utilize the edition of the listed document as identified in the "Design Criteria Notes" in the structural drawings. If not listed in the "Design Criteria Notes", use the edition adopted or referenced by the listed governing building code or material standard. If no specific edition is adopted, use the latest edition.
 - 1. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
 - 2. ASTM A36 - Standard Specification for Carbon Structural Steel.
 - 3. ASTM A48 - Standard Specification for Gray Iron Castings.
 - 4. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 5. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

6. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
7. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
8. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
9. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
10. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
11. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
12. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
13. ASTM A1011 - 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.
14. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
15. ASTM F3125 - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength.
16. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
17. AWS B2.1 - Specification for Welding Procedure and Performance Qualification.
18. AWS D1.1 - Structural Welding Code - Steel.
19. AWS D1.2 - Structural Welding Code - Aluminum.
20. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
21. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic).
22. SSPC-SP 2 - Hand Tool Cleaning.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer licensed in the State in which the Project is located.
- C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1 and dated no more than 12 months before start of scheduled welding work.

1.06 QUALITY ASSURANCE

- A. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1, AWS D1.2, AWS D1.6 and dated no more than 12 months before start of scheduled welding work.

1.07 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 anchorages and steel weld plates and angles for casting into concrete. 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.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Wide Flange and WT Shapes: ASTM A992.
- B. M- and S- Shapes: ASTM A36.
- C. C- and MC- Shapes: ASTM A992.
- D. L- Shapes: ASTM A572 Grade 50.
- E. Round HSS: ASTM A500 Grade C (Fy = 46 ksi).
- F. Rectangular HSS: ASTM A500 Grade C (Fy = 50 ksi).
- G. Pipe: ASTM A53, Grade B (Fy = 35 ksi).
- H. All other Plate Material: ASTM A36 or ASTM A572 Grade 50.
- I. Stainless Steel, General: ASTM A666, Type 304.
- J. Stainless Steel Tubing: ASTM A554, Type 304.
- K. Stainless Steel Bars, Shapes and Moldings: ASTM A276, Type 304.
- L. Slotted Channel Fittings: ASTM A1011.
- M. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
- N. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.
- O. Bolts, Nuts, and Washers: ASTM F3125, Type 1, plain.
- P. Welding Materials: AWS D1.1 and AWS D1.6; type required for materials being welded.
- Q. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- R. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B221, 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209, 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210, 6063 alloy, T6 temper.
- D. Aluminum-Alloy Bars: ASTM B211, 6061 alloy, T6 temper.
- E. Aluminum-Alloy Sand Castings: ASTM B26.
- F. Aluminum-Alloy Die Castings: ASTM B85.
- G. Bolts, Nuts, and Washers: Stainless steel.
- H. Welding Materials: AWS D1.2; type required for materials being welded.

2.03 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.

- B. Steel Bolts, Nuts, and Washers: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
- D. Dissimilar Materials: Separate dissimilar surfaces in contact with or in close proximity to non-compatible metals, concrete masonry, or plaster with neoprene gasket; or other approved means.

2.04 FABRICATION

- A. Verify dimensions on site prior to shop fabrication.
- B. Fit and shop assemble items in largest practical sections, for delivery to site.
- C. Fabricate items with joints tightly fitted and secured.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- G. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- H. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.05 FABRICATED ITEMS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Operable Partition Supports: Fabricate supports for operable partitions as indicated on the Drawings.
- C. Bumper Posts and Guard Rails: As detailed; prime paint finish.
- D. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
- E. Joist Hangers: Strap anchors, fabricated with sheet steel; galvanized finish.
- F. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.
- G. Lintels: As detailed; prime paint finish.
- H. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4, as manufactured by Unistrut, or equal.
- I. Sill Angles for Tempered Glass Railing Assemblies: ASTM A36 steel angles with anchoring devices and sizes as indicated in shop drawings for railing assembly, drilled and tapped for fastener types, sizes, and spacing indicated, prime paint finish.
- J. Door Frames for Overhead Door Openings, and Wall Openings: Channel sections; prime paint finish.
- K. Recessed Mat Frames: As detailed; steel, galvanized finish.
- L. Foot Scrapers, Mud and Foot Grilles, and Pans: As detailed; aluminum, mill finish.
- M. Elevator Hoistway Divider Beams: Beam sections; prime paint finish.
- N. Elevator Pit Ladders: As detailed; comply with ASME A17.1.
- O. Toilet Partition Suspension Members: Steel channel sections; prime paint finish.

- P. Diamond Plate Metal Threshold: Fabricate from abrasive surface floor plate. Provide angle supports as indicated.
- Q. Safety Line Tiebacks
 - 1. Comply with California Occupational Safety and Health Act (CA-OSHA), and requirements per Code.
 - 2. Material:
 - a. Pipes – ASTM A53 or tubes A500.
 - b. Plates - ASTM A36 or A572 steel.
 - 3. Finish:
 - a. Hot-dipped galvanized after fabrication.

2.06 FINISHES - STEEL

- A. Prime paint steel items.
 - 1. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
- B. Prepare surfaces to be primed in accordance with SSPC-SP2.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: One coat.
- E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123 requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
- F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123 requirements.
- G. Chrome Plating: ASTM B177, nickel-chromium alloy, satin finish.
- H. Slotted Channel Framing: ASTM A653, Grade 33.
- I. Stainless Steel Finish: No. 4 Bright Polished finish.

2.07 FINISHES - ALUMINUM

- A. Exterior Aluminum Surfaces: Class I color anodized.
- B. Interior Aluminum Surfaces: Class I natural anodized.
- C. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.08 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

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on drawings.
- D. Perform field welding in accordance with AWS D1.1, AWS D1.2, or AWS D1.6.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- G. Corrosion Protection: Coat concealed surfaces of aluminum that will 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.

3.04 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. Install items plumb and level, accurately fitted, free from distortion or defects.
- C. Perform field welding in accordance with AWS D1.1/D1.2/D1.6.

3.05 INSTALLING SUPPORTS FOR OPERABLE PARTITIONS

- A. Anchor supports for operable partitions securely to and rigidly brace from building structure.

3.06 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing. Do not fill removable bollards with concrete.
- B. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- C. Fill bollards solidly with concrete, mounding top surface to shed water.

3.07 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

3.08 ADJUSTING AND CLEANING

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION

SECTION 05 51 36.16

METAL RAMPS

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Requirements apply to this Section.

1.02 SCOPE OF WORK SUMMARY

Supply and install all exterior and interior signage, as shown on Drawings and as specified herein, including all materials and labor for a timely, complete and proper installation.

1.03 STANDARDS AND REFERENCES

A. Ramps shall comply with all provisions of applicable local building codes, so long as Handi-Ramp is provided with a copy of the local building codes.

1.04 QUALITY ASSURANCE

A. Design of the Aluminum members shall conform to the current edition of the Aluminum Association specifications for Aluminum structures.

B. Aluminum welding shall be in accordance with the ANSI/AWS D1.2-90 Gas Metal Arc Welding Process.

C. All exposed surfaces shall be free of sharp or jagged edges.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

Provide in accordance with Section 01 33 00 Submittal Procedures.

1.07 DELIVERY, STORAGE, AND HANDLING

Comply with the requirements of Section 01 66 00 Product Storage and Handling Requirements.

1.08 PROJECT CONDITIONS

A. Comply with the requirements of Section 01 50 00 Construction Facilities

B. Comply with Manufacturer's Standard Requirements.

1.09 OPERATION AND MAINTENANCE DATA

Provide in accordance with Section 01 77 00 Project Closeout.

1.010 WARRANTY

Warranty: Manufacturer shall warrant its products to be free from defects in material and workmanship in the regular course of business for a minimum period of one (1) year beginning on the date of the invoice.

PART 2 - PRODUCT

2.01 MANUFACTURERS

A. Basis of Design: HandiRamp, 5600 99th Avenue, Unit A1, Kenosha, WI, 53144. Phone: (800) 876-7267, Web: www.handiramp.com.

2.02 PRODUCT

A. Ramp Sections

1. Engineering:

- a. Ramp sections shall be designed for a uniform live load of 50 lb per square foot or a concentrated load of 100 lb per square foot.

2.03 MATERIALS

A. Ramp sections are all aluminum construction from a combination of 5032-H32, 6061 and/or 6063 alloy.

B. Walking surface is made from 1/8" thick aluminum sheet with a perforated-button design for traction. Walking surfaces shall meet Federal Specification RR-G-1602 governing slip resistance.

C. Sides of ramp are made from a custom extruded aluminum shape or 2" x 2 1/2" aluminum angle.

D. Understructure is made from 3/4" square or 1 1/4" aluminum tubing, size varies with width.

E. Walking surface, sides and understructure are welded together as a unit.

1. Design:

- a. Ramp sections shall be fabricated in lengths between 4 ft to 10 ft long.
- b. Ramp walking surface shall be 36", 48", 52" or 60" wide.
- c. The walking surface of the ramp shall be continuous, without gaps, 1/8" thick aluminum deck with slip resistant surface in a perforated- button tread design.
- d. All ramp sections shall have a side safety curb of at least 2 inches.

2.04 PLATFORMS

A. Engineering: Platform shall be designed for a uniform live load of 50 lb per square foot or a concentrated load of 100 lbs. per square foot.

B. Materials:

1. Platforms shall be of aluminum construction, either 5052-H32, 6061 or 6063 alloy.

- a. Walking surface is made from 1/8" thick aluminum sheet with a perforated-button design for traction. Walking surface shall meet Federal Specification RR-G-1602 governing slip resistance.
- b. Sides of platform are made from a custom extruded aluminum shape or 2" x 2 1/2" aluminum angle.
- c. Understructure is made from 3/4" square or 1 1/4" aluminum tubing, size varies with width.
- d. Walking surface, sides and understructure are welded together as a unit.

C. Design:

1. Platform shall be fabricated in section, dependent on ramp widths and turning circumference needed.
2. The walking surface of the platform shall be continuous, without gaps, 1/8" thick aluminum deck with slip resistant surface in a perforated button tread design.
3. All platform sections shall have a side safety curb of at least 2 inches except

where platform meets building and where platform meets ramp.

2.05 LEGS

A. Engineering: Legs shall be designed to support the ramp and platform sections.

B. Material:

1. Legs for Ramp Sections shall be constructed of a Brace made from 1 ¼" square aluminum tubing welded to an aluminum channel (two legs per channel). Leg Braces shall be placed at ramp connection points and at the midpoint of the 8', 9', or 10' long ramps.
2. Legs for Platform shall be constructed of square steel tubing with rounded edges in a sleeve type construction. The outside tubing shall have an outside dimension of 2 inches. The inside tubing shall have an outside dimension of 1 ¾" inch with wall thickness of 1/8" inch.
3. Legs shall have adjustable screw type mounting foot terminating in a flat steel pad with a minimum dimension of 4" x 4" and a minimum of 1/8" thickness.
4. All fasteners shall be made of stainless steel.

C. Design:

1. Legs shall be attached to the ramp and platform. Legs shall be designed so that they are always perpendicular to the ground, and the load shall remain vertical regardless of the slope.
2. Rough adjustment of the legs shall be in 1-inch increments with fine adjustment accomplished by a screw type mounting foot.

2.06 HANDRAILS: DOUBLE-BAR

A. Materials:

1. Handrails shall be constructed from approximately 1-1/2" diameter Steel Tubing, formed and welded.
2. Handrail receptor cups shall be constructed from aluminum tubing and welded to the to the ramp curb.

B. Design:

1. Handrail load capacity is 100 lbs. per LFT.
2. Handrails surface shall be smooth and continuous for each ramp section and shall have smooth, interconnecting sections between ramp and platform sections.
3. Top of the handrail shall be placed between 34 and 38 inches above the walking surface of the ramp or platform structure.
4. Handrails shall be mounted in the receptor cups and secured by nut, bolt and washer fasteners.
5. Handrail ends shall have a 1-foot return at top or bottom locations where they are not connected to other sections or where the handrails do not terminate at a wall or extend into cross traffic. Where the termination point does not have a return the end shall be finished in a rounded termination at the upright support.

2.07 FINISHING

A. Handrails shall be machine primed and finish painted in "Silver Aluminum" or "Gloss Black" Corrosion resistant water based paint unless order states otherwise.

2.08 GENERAL

- A. There shall be no rubber or plastic plugs utilized on handrails, guardrails or any other surface. Any open tube items shall be finished with welded caps of the same material. All welds in these situations shall be of smooth finish.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Verify field conditions are acceptable and are ready to receive work
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 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.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Structural dimension lumber framing.
- B. Exposed timber structural framing.
- C. Nonstructural dimension lumber framing.
- D. Rough opening framing for doors, windows, and roof openings.
- E. Sheathing.
- F. Preservative treated wood materials.
- G. Fire retardant treated wood materials.
- H. Miscellaneous framing and sheathing.
- I. Communications and electrical room mounting boards.
- J. Concealed wood blocking, nailers, and supports.
- K. Drilling, saw cuts, knock-outs and framing for ventilation.
- L. Wood sheathing backing at tile walls.
- M. Miscellaneous wood nailers, furring, and grounds.
- N. Steel hardware and attachment brackets

1.03 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 03 30 00 - Cast-in-Place Concrete: Setting anchors in concrete.
- C. Section 05 12 00 - Structural Steel Framing: Prefabricated beams and columns for support of wood framing.
- D. Section 05 50 00 - Metal Fabrications: Miscellaneous steel connectors and support angles for wood framing.

1.04 REFERENCE STANDARDS

- A. Utilize the edition of the listed document as identified in the "Design Criteria Notes" in the structural drawings. If not listed in the "Design Criteria Notes", use the edition adopted or referenced by the listed governing building code or material standard. If no specific edition is adopted, use the latest edition.
 - 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 4. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
 - 5. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

6. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar. AWWA - Wood Preservative: American Wood-Preservers' Association:
 - a. U1, Use Category System: User Specification for Treated Wood.
 - b. M4, Standard for the Care of Preservative-Treated Wood Products.
7. AWS B2.1 - Specification for Welding Procedure and Performance Qualification.
8. AWS D1.1 - Structural Welding Code - Steel.
9. ICC (CBC) – California Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
10. ICC (IECC) - International Energy Conservation Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
11. NDS – National Design Specification for Wood Construction
12. SDPWS - Special Design Provisions for Wind & Seismic
13. PS 1 - Structural Plywood.
14. PS 2 - Performance Standard for Wood Structural Panels.
15. PS 20 - American Softwood Lumber Standard.
16. RIS (GR) - Standard Specifications for Grades of California Redwood Lumber.
17. WCLIB - Standard Grading Rules for West Coast Lumber No. 17.
18. WWA - Western Lumber Grading Rules.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Certification:
 1. Preservative Treated Wood: Certification for waterborne preservative and that moisture content was reduced to 19 percent maximum, after treatment.
- C. Shop-fabricated structural wood: Submit manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if shop-fabricated structural wood is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.
- D. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1 and dated no more than 12 months before start of scheduled welding work.

1.06 QUALITY ASSURANCE

- A. General:
 1. Coordinate the work of all trades to ensure proper placement of all materials, anchors, etc., as well as providing for openings and anchors for the installation of surface mounted materials and equipment.
 2. Qualifications for Workers: Provide sufficient skilled workers and supervisors who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of construction involved and the materials and techniques specified.
 3. Rejection: In the acceptance or rejection of rough carpentry, no allowance will be made for lack of skill on the part of the workers.
- B. Tests and Inspections:
 1. A testing program is required prior to start of construction. Testing program to be done in Compliance with the CBC requirements and in collaboration with Testing Laboratory, Design team, contractor, owner and submitted for review by the agency in charge of building enforcement. Requirements below are minimum requirements; additional requirements may be required in final testing program.

- C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1 and no more than 12 months before start of scheduled welding work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Protection:
 - 1. After delivery, store all materials off the ground, covered, and in such a manner as to ensure proper ventilation and drainage and to protect against damage and the weather. Maintain wood at the maximum moisture levels indicated in Materials Section.
 - 2. Keep all material clearly identified with all grade marks legible; keep all damaged material clearly identified as damaged, and separately store to prevent its inadvertent use. Do not allow installation of damaged or otherwise non-complying material.
 - 3. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.
 - 4. Use all means necessary to protect the installed work and materials of all other trades.
 - 5. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective work within a two-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber:
 - 1. Meet requirements of following minimum grades. All grades shall be per WCLIB Grading Rules No. 17 or WWPA Western Lumber Grading Rules. Species Combination shall be Douglas Fir – Larch. Douglas Fir – Larch (North) and Douglas Fir (South) are not permitted without approval from the structural engineer.
 - 2. Furnish S4S unless otherwise noted.

2.02 SOURCE QUALITY CONTROL

- A. Grade Mark each piece of lumber. Marking must be done by recognized agency.
 - 1. Douglas Fir shall bear WCLIB or WWPA grade stamp.
 - 2. Pressure treated Douglas Fir shall bear AWP Quality mark.
- B. Wood Sheathing: Each panel shall be legibly identified as to type, grade and species by APA grade. If plies are spliced, the slope of the scarf shall not be steeper than 1:8. White pockets will not be permitted in face plies.

2.03 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Western Wood Products Association; WWPA or West Coast Lumber Inspection Bureau; WCLIB.
- B. Sizes: Size to conform to rules of governing standard. Sizes shown are nominal unless otherwise noted.
- C. Materials:
 - 1. Dimensional Lumber and Timbers:
 - a. Maximum Moisture Content at Initial Use: As indicated on the Drawings
 - b. Species: As indicated on the Drawings.
 - c. Grade: As indicated on the Drawings.

- D. Maximum Moisture Content "at Initial Use" shall be that point at which nails, screws, bolts, split rings, shear plates or other fasteners or the holes for said fasteners are placed in the wood.
- E. All dimension lumber is assumed to be enclosed in the dry building envelope in the final service condition, unless noted otherwise, and free to dry to moisture content less than 19%.
- F. All studs, plates, joists, rafters and beams 3x and thicker shall be free of heart center in accordance with the specified grading standards.

2.04 DIMENSION LUMBER FOR EXPOSED EXTERIOR APPLICATIONS

- A. Submit manufacturer's certificate that products meet or exceed specified requirements, in lieu of grade stamping.
- B. Sizes: Size to conform to rules of governing standard. Sizes shown are nominal unless otherwise noted.
- C. Materials:
 - 1. Dimensional Lumber and Timbers:
 - a. Maximum Moisture Content at Initial Use: As indicated on the Drawings.
 - b. Species: As indicated on the Drawings.
 - c. Grade: As indicated on the Drawings.
- D. All studs, plates, joists, rafters and beams 3x and thicker shall be free of heart center in accordance with the specified grading standards.

2.05 SHOP-FABRICATED STRUCTURAL WOOD

- A. At Contractor's option, shop-fabricated structural wood may be substituted for concealed dimension lumber and timbers.
- B. Shop-fabricated structural wood: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.
 - 1. Columns: Use laminated veneer lumber, laminated strand lumber, or parallel strand lumber with manufacturer's published modulus of elasticity, E: 1,800,000 psi, minimum.
 - 2. Beams: Use laminated veneer lumber, laminated strand lumber, or parallel strand lumber with manufacturer's published modulus of elasticity, E: 1,800,000 psi, minimum.
 - 3. Headers Not Longer Than 48 inches: Use laminated veneer lumber, laminated strand lumber, or parallel strand lumber.
 - 4. Products:
 - a. Boise Cascade Company: www.bc.com.
 - b. RedBuilt LLC: www.redbuilt.com.
 - c. Weyerhaeuser Company: www.weyerhaeuser.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2.06 WOOD SHEATHING

- A. Floor Sheathing : PS 1 or PS 2 APA rated sheathing.
 - 1. Thickness and Type: As indicated on Drawings.
 - 2. Glue: Exterior
 - 3. Edges: Tongue and groove.
- B. Roof Sheathing : PS 1 or PS 2, APA rated sheathing.
 - 1. Thickness and Type: As indicated on Drawings.
 - 2. Glue: Exterior
 - 3. Edges: Square.
- C. Wall Sheathing : PS 1 or PS 2, APA rated sheathing.
 - 1. Thickness and Type: As indicated on Drawings.
 - 2. Glue: Exterior
 - 3. Edges: Square.

- D. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- E. Other Applications:
 - 1. Where indicated on the Architectural Drawings as interior wall backing behind tile and in all toilet rooms behind sheet rock, to be C-C APA rated sheathing with exterior glue. Thickness shall be 5/8-inch at all locations.
 - 2. Flooring: C-C APA Performance rated tongue and groove with exterior glue. Thickness type and grade shall be as indicated on the Drawings.
 - 3. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
 - 4. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
 - 5. Other Locations: PS 1, C-D Plugged or better.

2.07 ACCESSORIES

- A. Rough Hardware Fastenings and Connections: All types including bolts, lag screws, nails, spikes, screws, washers and other rough hardware, of kinds that may be purchased and that require no further fabrication, shall be furnished and installed for all finish and rough carpentry and shall conform to NDS Standards and dimensions. All hardware exposed to weather shall be hot-dipped galvanized per ASTM A153 Standards. All nails used into pressure treated lumber shall be hot-dipped galvanized per ASTM A153 or stainless steel.
 - 1. Common wire nails or spikes shall be used unless noted otherwise on the Drawings. Box nails and sinker nails are not permitted. Vinyl coating is permitted on nails when not exposed to weather. Nails and staples shall conform to requirements of CBC.
 - 2. Bolts: Bolt material shall conform to ASTM A307, Grade A. Bolt dimensions shall conform to ANSI/ASME B18.2.1 with hex head of sizes indicated.
 - 3. Lag Screws: Lag screws shall conform to ASTM 307, Grade A. All lag screws shall have hex heads where exposed.
 - 4. Washers: Standard flat washers shall conform to ANSI B18.22.1, Type A, Wide Pattern. Steel plate washers shall be Simpson BP or BPS or equivalent. Malleable iron washers shall be standard malleable iron washers.
 - 5. Power-Actuated Fasteners: Tempered steel pins with special corrosive resistant plating or coating. Pins shall have guide washers to accurately control penetration. Fastening shall be accomplished by low-velocity piston-driven power activated tool. Pins and tool shall be as manufactured by Hilti Fastening Systems or equivalent. See Drawings for size, type and embedment.
 - 6. Expansion Anchors: See Section 03 30 00 for anchors to concrete and Section 04 20 00 for anchors to masonry.
 - 7. Adhesive Anchors: See Section 03 30 00 for anchors to concrete and Section 04 20 00 for anchors to masonry.
 - 8. Fabricated Metal Timber Framing Connectors: Connectors shall be punched for nailing and bolting. Nails and nailing shall conform to the manufacturer's instructions with a nail provided for each punched hole. All connectors must have specific ICC approval. Types as noted on Drawings are Simpson Strong-Tie. Hardware suppliers other than Simpson shall submit a comparative material list itemizing product designation, load rating and supported member size for review by the enforcement agency and the Structural Engineer.
 - a. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653.
 - 9. Steel Connections and Brackets: ASTM A36 weldable quality, galvanize per ASTM A123 or ASTM A666, Type 304 stainless steel where indicated on the Drawings.
 - a. Fabricate steel hardware and connections with joints neatly fitted, welded, and ground smooth
 - b. Welding: Perform welding in accordance with AWS D1.1.

10. Anchor Bolts: ASTM F1554 Gr. 36 heavy hex headed anchor rods and ASTM A563 nuts; hot-dip galvanized to meet requirements of ASTM A153, matching washers.
- B. Building Paper: Fed. Spec. UU-B-790a, Type I, Grade B (15 lb. min. unless noted elsewhere).
- C. Subfloor Adhesives: Gap-filling construction adhesive for bonding wood structural panels to wood-based floor system framing; complying with ASTM D3498.
- D. General Purpose Construction Adhesives: Comply with ASTM C557.
- E. Radiant Barrier: Aluminum radiant barrier; designed for factory laminating to roof sheathing.
 1. Products:
 - a. Louisiana-Pacific Corporation; TechShield: www.lpcorp.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 PREPARATION

- A. Inspection:
 1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly proceed.
 2. Verify that rough carpentry may be performed in strict accordance with the original design and all pertinent codes and regulations.
- B. Discrepancies: In the event of discrepancy, immediately notify Architect. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
- C. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Protect all work in progress and all work installed, as well as the work of all other trades. Any work damaged as a result of the work under this section shall be corrected to its original condition or replaced if directed by the Architect at no increase in cost to the Owner.
- B. Ventilation: Contractor shall include all labor and materials necessary to provide ventilation requirements of roof overhangs, eaves, attics, and all other components of the building required by codes to be ventilated. Work shall include removing knock-outs in wood I-joists for cross ventilation, drilling of blocking, wood sheathing, and other wooden components of the structure necessary to comply with requirements of the CBC for ventilation of buildings.
- C. Select material sizes to minimize waste.
- D. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- E. General: All rough carpentry shall produce joints true, tight, and well nailed with all members assembled in accordance with the Drawings and with all pertinent codes and regulations.
- F. Selection of Lumber Pieces: Carefully select all members. Select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing or making proper connections. Cut out and discard all defects which will render a piece unable to serve its intended function.
- G. Lumber may be rejected by the Architect, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting.
- H. Shimming: do not shim any framing component.
- I. Care shall be taken that notching and boring of members is in strict conformance with the Drawings and that there are no over-cuts.
- J. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 INSTALLATION - FRAMING AND ROUGH CARPENTRY

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Sills: Shall be in long lengths of sizes shown, fastened with anchor bolts as indicated, a minimum of two anchor bolts per piece. Place steel plate washers (but not standard flat or malleable iron washers) under nuts bearing on wood. Set sills level and true.
- D. Studs, Posts and Columns: Shall be full length. Corners shall be as detailed. Partitions or walls containing plumbing, heating or other piping shall be so formed as to give proper clearance for materials. Cut members as required to provide full bearing at ends. Connect to structure as indicated.
- E. Plates: Shall be full length of wall segment or 12-foot minimum and spliced as shown.
- F. Joists and Beams: Shall be full span length and spliced over bearings unless shown otherwise. Install with crown side up. Beams or headers indicated to be built up of two or more joists shall be fabricated on the job using full length members. For two piece 2x members, stitch nail pieces together with 16d common nails spaced not over 12 inches c.c. and staggered. Clinch nails protruding through members. For three or more piece members, stitch bolt pieces together with ½" bolts spaced not over 12 inches c.c. and staggered.
 - 1. Provide double joists and headers at all openings through roof unless otherwise shown on Drawings.
 - 2. Provide typical headers at all openings through walls where one or more studs are required to be cut. For penetration through walls narrower than stud spacing, provide solid blocking on all sides for fastening finish materials.

3.04 INSTALLATION - BLOCKING, NAILERS, AND SUPPORTS

- A. Blocking: Blocking shall be same thickness and width of studs or joists unless shown otherwise. Blocking shall not be spaced over 8'-0" c.c. Install fire blocking in accordance with CBC. Horizontal fire blocking in walls shall be placed at floor lines and ceiling lines unless noted otherwise. Install blocking at all sheathing joints where noted on the Drawings. Install wall width full height solid blocking at floor joists beneath all posts in walls. Blocking shall be installed around all wall, floor and roof penetrations.
- B. Provide the following specific nonstructural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Towel and bath accessories.
 - 6. Wall-mounted door stops.
 - 7. Chalkboards and marker boards.
 - 8. Wall paneling and trim.
 - 9. Joints of rigid wall coverings that occur between studs.

3.05 INSTALLATION - SHEATHING

- A. Wood Sheathing: Install to pattern indicated and provide blocking at joints where noted on the Drawings. Center all joints over bearing supports. Nail to framing as indicated. Install wood sheathing with face plies perpendicular to joists unless indicated otherwise. Wall wood sheathing shall continue uninterrupted by ceilings or soffit from floor to floor or floor to roof unless specifically detailed on the Structural Drawings.

3.06 INSTALLATION - FASTENERS

- A. Nailing: Except as otherwise indicated on Drawings or specified, all nailing shall be as required by CBC Table 2304.10.2 - Fastening Schedule.
 - 1. Nails or Spikes shall be common wire unless noted otherwise. Penetration of nails or spikes shall be one-half the length of the nail or spike into the piece receiving the point. However, to connect pieces 2" in thickness, 16d nails shall be used unless noted otherwise.
 - a. Bore holes for nails wherever necessary to prevent splitting.
 - b. Use finish or casing for finish work.
 - c. Use of machine nailing is subject to a satisfactory installation of nails. Minimum edge distances shall be maintained. Nails installed through sheathing with nail guns shall not penetrate into the outer plies deeper than hand nailing. Submittal of guns and nails is required.
 - d. All nailing into Pressure-Treated lumber shall utilize hot-dipped zinc coated galvanized nails or stainless steel nails per CBC.
- B. Bolts and Lag Screws: Bolts shall be sizes indicated on Drawings. Holes for bolts shall be 1/16-inch larger than the bolt diameter. Malleable, Steel plate or standard flat washers shall be used where heads or nuts would otherwise bear directly on wood surfaces. Malleable or plate washers shall be used on all anchor bolts. Cut washers are not permitted. Lag screws shall be screwed (not driven) into place. For the shank, holes shall be bored the same depth and diameter as shank. For threaded portion, holes shall be pre-drilled to 50% of the shank diameter, except as follows:
 - 1. 7/8" Diameter Lag Screw: Pre-Drill 1/2" diameter hole.
 - 2. 1" Diameter Lag Screw: Pre-Drill 5/8" diameter hole.
 - 3. Soap Lag screws prior to installation.
 - 4. Tighten all bolts and screws before closing in.
- C. Framing Devices: Install according to the manufacturer's instructions unless otherwise noted.

3.07 INSTALLATION, MISCELLANEOUS

- A. Install all items under other sections specified to be furnished and installed in other sections which relate to the rough carpentry work.
- B. Miscellaneous Carpentry Work not included under other sections but, indicated or required yet not specified elsewhere shall be furnished and installed hereunder, including appropriate fastening devices. Contractor shall provide miscellaneous carpentry work for all sections and divisions of work identified.
- C. Wood Furring, Stripping: Install as shown or required to provide nailing materials or passage of pipes, conduits, etc., not otherwise accommodated including ceiling stripping for gypsum drywall construction.
- D. Bridging: Space not over 8'-0" c.c. for spans over 16'-0". Joists 8 inches or less in depth shall not require bridging unless specifically indicated.
- E. Solid Wood Backing: Solid wood backing shall be provided for all wall and ceiling finishes and for supporting of mounted items for all trades, including but not limited to metal toilet partitions, toilet room accessories, frames, cabinets, casework, mirrors, trim, applied wall finishes, athletic equipment, food service equipment, piping, conduit, ducts, etc. Contractor shall coordinate placement of backing and supports with Subcontractor supplying mounted items.
- F. Building Paper: Install in all locations indicated except where included in other sections of the specifications.
- G. Cant Strips and Crickets: Shape to sizes shown. Rigidly fasten to construction. Form neat mitered corners.
- H. Wood Sheathing Backing: All toilet rooms, restrooms, single or joint occupancy shall have all walls backed with 5/8-inch thick wood sheathing with no surface voids. Install sheathing

between the framing members and wallboard. The same wood sheathing shall also be provided and installed at all tile locations. At tile locations wood sheathing shall be installed between the framing members and the resin-cement backing board.

- I. Wood Curbs for Equipment: Construct all wood curbs for roof mounted equipment as detailed. Provide all miscellaneous blocking, bracing, supports, and other wood items as shown or required to complete the work.
- J. Plywood Backing for Electrical, telephone, and similar types of wall mounted equipment shall be provided hereunder where required. Plywood shall be 3/4-inch thick exterior A-C plywood with 'A' face exposed.
- K. Fire/Draft Stops: Construct fire and drafts stops in furred attic spaces where indicated or required by CBC code. Unless otherwise indicated on Drawings construct of not less than 5/8-inch Type 'X' gypsum wallboard or 1/2" wood sheathing, adequately supported by 2x4's at 24 inches c.c., braced diagonally to the roof structure. Draft stop and installation work shall conform to code requirements.
- L. Shoring and Bracing: Shore or brace for temporary support of all work as required during the construction period except any shoring and bracing specified and included under other sections of these specifications.

Temporary Enclosures: Provide and maintain all barricades and enclosures required to protect the work in progress.
- M. Protect all work in progress and all work installed, as well as the work of all other trades. Any work damaged as a result of the work under this section shall be corrected to its original condition or replaced if directed by the Architect at no increase in cost to the Owner.
- N. Ventilation: Contractor shall include all labor and materials necessary to provide ventilation requirements of roof overhangs, eaves, attics, and all other components of the building required by codes to be ventilated. Work shall include removing knock-outs in wood I-joists for cross ventilation, drilling of blocking, wood sheathing, and other wooden components of the structure necessary to comply with requirements of the CBC for ventilation of buildings.

3.08 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

3.09 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.
- C. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.10 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.

3.11 CLEANING

- A. Waste Disposal: See Section 01 74 19 - Construction Waste Management and Disposal.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

3.12 SCHEDULES

- A. Lower Level Floor Joists: MSR Lumber.
- B. Upper Level Floor and Ceiling Joists, Rafters: Spruce-Pine-Fir, No. 2 Grade.
- C. Exposed Beams: Western Cedar, Select Structural Grade.

END OF SECTION

SECTION 06 41 00

ARCHITECTURAL CASEWORK

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract requirements and Division 1, General Conditions apply to this section.

1.02 SCOPE OF WORK SUMMARY

A. Section Includes:

1. Plastic laminate casework
2. Quartz countertops
3. Hardware typically furnished by the casework manufacturer
4. Shelving
5. Structural supports incorporated into wood casework

B. Excluding:

1. Metal support brackets and fittings that are part of the building structure
2. Plumbing, electrical fixtures, and telephone equipment

C. Related sections:

1. Rough carpentry: Wood blocking or grounds inside finished walls or above finished ceilings
2. Plumbing: Fixtures and fittings installed in countertops

1.03 STANDARDS AND REFERENCES

- A. The *North American Architectural Woodwork Standards (NAAWS)*, latest edition. Jointly published by Woodwork Institute and the Architectural Woodwork Manufacturers Association of Canada.
- B. NEMA LD-3, High Pressure Decorative Laminate, latest edition
- C. ANSI 208.1, Particle Board, latest edition
- D. ANSI 208.2, MDF, latest edition

1.04 QUALITY ASSURANCE

A. Work shall be in accordance with the Grade or Grades specified of the *North American Architectural Woodwork Standards*.

B. Certified Compliance Program (CCP):

1. Before delivery to the job site, provide a Woodwork Institute Certified Compliance Certificate indicating the millwork and countertop products being supplied and certifying that these products fully meet the requirements of the NAAWS Grade or Grades specified.
2. Provide a Woodwork Institute Certified Compliance Label on each countertop and elevation of casework.
3. At completion of installation provide a Woodwork Institute Certified Compliance Certificate indicating the products installed, and certifying that the installation of these products fully meets the requirements of the NAAWS Grade or Grades specified.

4. All fees charged by the Woodwork Institute for its Certified Compliance program are the responsibility of the millwork manufacturer and/or installer and shall be included in their bid.

C. Qualification:

1. A Woodwork Institute Accredited Millwork Company in good standing.
2. Firm (woodwork and countertop manufacturer) with no less than five years of production experience similar to a specific project, whose qualifications indicate the ability to comply with the requirements of this section.
3. The woodwork manufacturer must have at least one project in the past five years where the value of the woodwork was within 20 percent of the cost of woodwork for this project.

D. Single source responsibility: A single manufacturer shall provide and install the work of described in this section.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

A. Provide in accordance with Section 01 33 00 Submittal Procedures.

B. Shop drawings:

1. Submit shop drawings in conformance with the requirements of the *North American Architectural Woodwork Standards*.
2. Furnish a Woodwork Institute Certified Compliance Label on the first page of the shop drawings.
3. Submit one digital copy which will be returned with reviewed notations. Make corrections noted (if any), and distribute required copies prior to the start of work.

C. Samples:

1. Submit four finished samples of each species and cut of wood to be used. Lumber samples to be minimum 6 inches by 18 inches, and sheet product samples to be minimum 12 inches square. Samples shall represent the range of color and grain expected to be provided.
2. Submit four unfinished samples of each product to be provided for job-site painting or finishing. Lumber samples to be minimum 6 inches by 18 inches, and sheet goods to be 12 inches square.
3. Submit a sample of each plastic laminate, and/or solid surface color and pattern to be used.

1.07 DELIVERY STORAGE AND HANDLING

A. Comply with the requirements of Section 01 66 00 Product Storage and Handling Requirements.

B. Coordinate fabrication, delivery, and installation with the general contractor and other applicable trades.

C. Deliver materials only when the project is ready for installation and the general contractor has provided a clean storage area.

1. Delivery of architectural millwork shall be made only when the area of operation is enclosed, all plaster and concrete work is dry and the area broom clean.

2. Maintain indoor temperature and humidity within the range to be expected after occupancy.

1.08 PROJECT CONDITIONS

Comply with the requirements of Division 00.

1.9 RECORD DRAWINGS

Comply with the requirements of Section 01 77 00 Project Closeout.

1.10 WARRANTY

Provide Manufacturer's Standard Warranty in accordance with Section 01 78 36 Warranties.

PART 2 – PRODUCTS

2.01 MILLWORK COMPONENTS

- A. Lumber: In accordance with the *North American Architectural Woodwork Standards* Grade specified for the product being fabricated. Moisture Content: 6% to 12% for boards up to 2-inch (50.8 mm) nominal thickness, and shall not exceed 19% for thicker pieces.
- B. Core:
 1. Particleboard meeting the requirements of *North American Architectural Woodwork Standards*.
 - a. Water-resistant core, where required: Medium Density Fiberboard meeting the requirements of ANSI A208.2 Grade 130 MR-50.
- C. Veneer core plywood: A non-telegraphing hardwood manufactured with exterior glue.
- D. Plastic laminate: Meeting the requirements of the *North American Architectural Woodwork Standards* for its use.
 1. High pressure laminated plastic conforming to NEMA LP-3, 0.048-inch thickness for tops and 0.028-inch thickness for vertical surfaces.
 2. Low Pressure Melamine for exposed interior and semi-exposed surfaces.
 3. Backing sheet: LD-3-BK 20 backing grade undecorated plastic laminate.
- E. Edgeband: 3mm PVC for doors and drawer fronts and 1mm for cabinet body & shelves of the same pattern and color as the exposed surfaces.
- F. Hardboard: PS-58, pressed wood fiber with resin binder, tempered grade, smooth two sides for drawer bottoms.
- G. Adhesives: Type II, water-resistant typical. Type I, fully waterproof at sink tops and sink cabinets.
- H. Hardware:
 1. Finish: Satin aluminum unless noted otherwise.
 2. Pulls: Amerock 10BX40515G10 or Architect approved equal.
 3. Drawer guides for Drawers 24" wide or less: 100-pound capacity, full extension, ball bearing. Accuride 3832 or Architect approved equal.
 4. Drawer guides for File, Paper Storage and Heavy-Duty Drawers 42" wide or less: 150-pound capacity, over travel extension, ball bearing. Accuride 4043 or Architect approved equal.
 5. Hinges: Concealed, European style, self-closing, Grade II hinges minimum 120 degree opening.

6. Shelf supports: Knape & Vogt KV 255 or Architect approved equal.
7. Shelf clips: Knape & Vogt KV 256 or Architect approved equal.
8. Locks: Provide on all doors and drawers unless noted otherwise in Drawings.
 - a. Door locks: Olympus Door Lock 100 series or Architect approved equal.
 - b. Drawer locks: Olympus Door Lock 200 series with re-keying feature or Architect approved equal.
 - c. Keying: Contractor to confirm with client keying type and quantities prior to construction.
9. Miscellaneous Accessories: Provide grommet(s) as indicated in the Drawings.

2.02 MILLWORK FABRICATION

- A. Grade: NAAWS Custom Grade.
- B. Exposed exterior surfaces: High-pressure decorative laminate Grade VGS. Color and pattern as indicated in the Drawings.
- C. Exposed interior (open cases) and semi-exposed (behind doors) interior surfaces: White melamine.
- D. Cabinet construction type: Frameless.
- E. Door Interface Style: Flush overlay
- F. Edgebanding at all exposed and semi-exposed edges including doors, drawer fronts and false fronts: 3mm PVC of the same color and pattern as the exposed surfaces.
- G. Shelves: Adjustable shelves to be 1" thick.
- H. Doors and drawer fronts: High pressure laminate Grade VGS face, cabinet liner Grade CLS back.
- I. Drawer Boxes:
 1. Front and back: 1/2" particleboard with melamine surfacing.
 2. Sides: 1/2" Particle board with melamine surfacing
 3. Bottoms: 1/4" Hardboard with melamine surfacing
 4. Joinery: Dowels

2.03 COUNTERTOPS

- A. Grade: NAAWS Custom Grade
- B. Quartz Surface
 1. Manufacturer, Pattern, Color: As indicated in the Drawings
 2. Backsplash detail: Cove, 4" high minimum.
 3. Front edge: Eased edge

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which work of this Section will be performed.
- B. Correct conditions detrimental to timely and proper completion of the Work.
- C. Do not proceed until unsatisfactory conditions are corrected.

- D. Beginning of installation means acceptance of conditions.
- E. Verify that surfaces and openings are ready to receive work and field measurements are as shown on Shop Drawings and instructed by the fabricator. Verify dimensions for work of other trades incorporated into the casework.
- F. Verify the adequacy and proper location of any required backing or support framing.
- G. Verify that mechanical, electrical, plumbing, and other building components affecting work in this section are in place and ready.

3.02 INSTALLATION

- A. Install all work in conformance with the *North American Architectural Woodwork Standards*, latest edition.
 - 1. Installation shall conform to the *NAAWS* grade of the items being installed.
- B. All work shall be secured in place, square, plumb, and level.
- C. All work abutting other building components shall be properly scribed.
- D. Mechanical fasteners used at exposed and semi-exposed surfaces, excluding installation attachment screws and those securing cabinets end to end, shall be countersunk.
- E. Equipment cutouts shown on plans shall be cut by the installer.

3.03 ADJUSTING AND TOUCH UP

- A. Before completing installation, the installer shall adjust all moving and operating parts to function smoothly and correctly.
- B. All nicks, chips, and scratches in the finish shall be filled and retouched. Damaged items that cannot be repaired shall be replaced.

3.04 CLEANUP

- A. Upon completion of installation, the installer shall clean all installed items of pencil and ink marks and broom clean the area of operation, depositing debris in containers provided by the general contractor.

END OF SECTION

SECTION 07 05 00

CONCRETE FLOOR TESTING

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Requirements apply to this Section.

1.02 SCOPE OF WORK SUMMARY

- A. Administrative and procedural requirements for testing interior concrete slabs for moisture vapor emission rate, alkalinity, and temperature and humidity.
- B. Testing shall be conducted by the Contractor's Testing Agency.

1.03 STANDARDS AND REFERENCES

- A. ASTM F-1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor using Anhydrous Calcium Chloride.
- B. ASTM F-710 Standard Practice for Preparing Concrete Floors and other Monolithic Floors to receive Resilient Flooring.
- C. ASTM F-2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

1.04 QUALITY ASSURANCE

- A. Contractor Responsibilities: Contractor will engage a qualified testing agency to perform testing indicated.
 - 1. Contractor will furnish Owner with name, address, and telephone number of testing agency.
 - 2. Payment for testing services will be made by the Contractor directly to the testing agency.
 - a. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be paid by the Contractor.
- B. Testing Agency Responsibilities: Cooperate with Architect, Owner or Owner's Representative, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect, Owner or Owner's Representative, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the location from which test samples will be taken.
 - 3. Perform tests and submit a certified written report of each test, inspection, and similar quality-control service to Owner, Architect, Construction Manager and Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - 4. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - 5. Do not perform any duties of Contractor.
- C. Contractor Responsibilities: Coordinate sequence of activities to accommodate required testing services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities. Notify agency sufficiently in advance of operations to permit assignment of personnel.
2. Acclimate enclosed spaces to the anticipated occupied temperature and humidity as required by the manufacturer of the specified flooring material(s) and in accordance with ASTM testing requirements.
3. Cooperate with agencies performing required tests and inspections, provide reasonable auxiliary services as requested. Provide the following:
 - a. Access to the Work.
 - b. Incidental labor and facilities necessary to facilitate tests and inspections.
 - c. Security and protection for testing and inspecting equipment at Project site.
4. Project Meeting: Schedule and conduct project meeting not less than 30 days prior to flooring installation to discuss testing requirements, specifications and locations prior to testing. Attendees shall include Owner or Owner's Representative, Architect, Contractor, Testing Agency, and adhered floor installer representatives.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

- A. Provide in accordance with Section 01 33 00 Submittal Procedures.
- B. Reports: Reports of results of all testing shall be submitted by the Contractor's Testing Agency. Reports shall include the following:
 1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. For each test provide a record of interior temperature, humidity, moisture vapor emission, in-concrete relative humidity and alkalinity results for testing period.
 8. Test and inspection results and an interpretation of test results.
 9. Provide on the Architectural Floor Plan(s) as furnished by the Architect a test number identifying each test conducted.
 10. Name and signature of laboratory inspector.
 11. Recommendations on retesting and re-inspecting.

1.07 PROJECT CONDITIONS

Comply with the requirements of Section 01 50 00 Construction Facilities.

1.08 WARRANTY

Provide Manufacturer's Standard Warranty in accordance with Section 01 78 36 Warranties.

PART 2 – PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment to be provided by Testing Agency.
- B. American Moisture Test, Inc., Website: americanmoisturetest.com, Tel: (866) 670-9700.
 - 1. ASTM F1869 Moisture Vapor Emission Test kits
 - 2. ASTM F-2170 In-Concrete Relative Humidity Testing System
 - 3. ASTM F-710 Alkalinity-pH wide range 1 – 14pH meter

PART 3 – EXECUTION

3.01 EXAMINATION

Site: Weatherproofed, doors installed and windows secured. Do not start testing process when site has standing water, surface contaminants, exposed to exterior conditions or concrete installation is less than 90 days of age.

3.02 PREPARATION

- A. Contractor Responsibilities:
 - 1. Preparation of Substrates:
 - a. Prepare concrete substrates according to ASTM requirements.
 - b. Verify that substrates are dry and free of curing compounds, sealers, and hardeners for vapor emission testing per ASTM F-1869.
 - c. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 2. Temperature and Humidity: Maintain site at the temperature and humidity conditions to those anticipated during normal occupancy and maintain these conditions 48 hours prior and during testing period. If meeting this criteria is not possible, then minimum conditions should be 75± 10°F and 50± 10% relative humidity.
 - a. When a building is not under HVAC control, record temperature and humidity at start and end of testing using a portable data logging system.

3.03 TESTING

- A. Testing: Testing Agency shall perform tests as follows:
 - 1. Water vapor emission testing, ASTM F 1869.
 - a. Perform all gram scale weights on site.
 - b. Expose dome for 60 to 72 hours.
 - c. Report results as pounds of emission per 24 hours per ASTM F-1869.
 - d. Perform subfloor moisture testing in accordance with the Manufacturer's requirements for each floor system type. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained
 - 2. In-Concrete Relative humidity testing, ASTM F 2170.
 - a. Satisfactory results shall have a maximum 75 percent relative humidity level measurement.

3. Alkalinity Testing:

- a. Apply neutral-pH solution to form a 1-inch diameter circle directly to interior of moisture dome.
 - b. Allow to absorb into concrete for 1 minute.
 - c. Apply flat tip pH meter to solution and document result as required by manufacturer.
 - d. Perform pH tests on concrete floors regardless of their age or grade level in accordance with the Manufacturer's requirements for each floor system type. PH level shall not exceed range of the Manufacturer's requirements for each floor system type. All test results shall be documented and retained
- B. Adhered floor coverings shall not be installed in areas where satisfactory test results have not been obtained.
- C. Consult Architect on remedial measures to reduce concrete levels prior to installing flooring. Installation of flooring deems acceptance of on-site conditions for a warranted application.

3.04 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
- B. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."
- C. Protect construction exposed by or for quality-control service activities.
- D. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 07 21 00

THERMAL INSULATION

PART 1 – GENERAL

1.01 SUMMARY

Division 0, Contract requirements and Division 1, General Conditions apply to this section.

1.02 SCOPE OF WORK SUMMARY

A. Furnish and install Thermal Insulation indicated on the Drawings and as specified herein.

B. The principal items of work include:

1. Thermal Insulation within roof.
2. Thermal Insulation within exterior walls.
3. Thermal Insulation within interior walls.

1.03 STANDARDS AND REFERENCES

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

1. ASTM C 518: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
2. ASTM C 578: Standard Specification for Rigid Cellular Polystyrene Thermal Insulation.
3. ASTM C 612: Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
4. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
5. ASTM E 96: Standard Test Methods for Water Vapor Transmission of Materials.
6. ASTM E 119: Standard Test Methods for Fire Tests of Building Constructions and Materials.

B. NFPA 285: Standard Fire Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load Bearing Wall Assemblies Containing Combustible Components.

1.04 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Upon completion of this portion of the Work, complete and post a certificate of insulation compliance in accordance with pertinent requirements of governmental agencies having jurisdiction.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

A. Provide in accordance with Section 01 33 00 Submittal Procedures.

B. Product data:

1. Materials list of items to be provided under this Section.

2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
3. Manufacturer's recommended installation procedures which, when accepted by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the work.

1.07 DELIVERY, STORAGE AND HANDLING

Comply with the requirements of Section 01 66 00 Product Storage and Handling Requirements.

1.08 PROJECT CONDITIONS

- A. Comply with the requirements of Division 00.
- B. Comply with Manufacturer's Standard Requirements.

1.09 OPERATION AND MAINTENANCE DATA

Provide in accordance with Section 01 77 00 Project Closeout.

1.10 RECORD DRAWINGS

Provide in accordance with Section 01 77 00 Project Closeout.

1.11 WARRANTY

- A. Provide Manufacturer's Standard Warranty in accordance with Section 01 78 36 Warranties.
- B. Contractor Guarantee: Contractor guarantees the work covered by this specification against all defects in material and workmanship for a period of not less than two (2) years from the date the Owner records Notice of Completion.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Provide thermal insulation as indicated on Drawings. Insulation shall comply with ASTM Testing Standards and local Energy Codes. Fire Hazard Classification, Flame Spread Index, Smoke Developed Index, Combustibility, and Fire Endurance Ratings as required by Code.
- B. Insulation shall be as manufactured by Certain-Teed, Johns-Manville, Owens-Corning, or Architect approved equal.

2.02 BATT INSULATION MATERIALS

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used at Contractor's option.
- B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665, friction fit.
 1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 2. Flame Spread/Smoke Developed: 25/50 or less in accordance with ASTM E84.
 3. Basis-of-Design:
 - a. Owens Corning Corp: Pink Next Gen Fiberglass Insulation
 - b. Recycled Content: minimum 55%
 - c. Certified Formaldehyde Free
 - d. Indoor Air Quality: Certified GreenGuard Gold

- C. Mineral Wool Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665, friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 - 1. Combustibility: Non-combustible when tested in accordance with ASTM E136.
 - 2. Basis-of-Design:
 - a. Owens Corning Corp: Thermafiber Insulation
 - b. Recycled Content: minimum 70%
 - c. Indoor Air Quality: Must meet or exceed standards established per California Department of Public Health Section 01350.
- D. Acoustic Batts: Unfaced, lightweight, flexible fiberglass acoustical insulation, complying with ASTM C 655, Type I.
 - 1. Basis of Design: Owens Corning Corp: PINK Next Gen Fiberglas Sound Attenuation Batts (SAB)
 - 2. Thickness: Per stud size, refer to Drawings.
 - 3. Width: 15 1/2 inches to 23 1/2 inches
 - 4. Length: 96 inches
 - 5. Surface Burning Characteristics: ASTM E84
 - a. Maximum flame spread: <25
 - b. Maximum smoke developed: <50
 - 6. ASTM E136: classified noncombustible
 - 7. Dimensional Stability: Linear shrinkage less than 0.1%.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which work of this Section will be performed.
- B. Correct conditions detrimental to timely and proper completion of the Work.
- C. Do not proceed until unsatisfactory conditions are corrected.
- D. Beginning of installation means acceptance of conditions.

3.02 PREPARATION

- A. Verify adjacent materials are dry and ready to receive installation.
- B. Verify mechanical and electrical services within walls have been installed and tested.

3.03 INSPECTION

- A. Before any installation is started, determine that the other work is suitable to receive insulation.
- B. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
- C. Remove or protect against projections in construction framing that may damage or prevent proper insulation.

3.04 INSTALLATION

- A. All work shall be performed by licensed applicators, shall comply with the recommendations of the manufacturer and the National Association of Insulation Manufacturers.
- B. Install insulation with factory applied membrane facing warm side of building spaces. Lap ends and side flanges of membrane over and between framing members. Secure in place. Tape seal butt ends and lapped side flanges. Tape seal tears or cuts in membrane.
- C. Trim insulation neatly to fit spaces. Use batts free of damage. Install batt insulation, in wall spaces without gaps or voids.
- D. Install Insulation in all indicated walls from floor to underside of roof. Secure batt insulation with 19-gage wire or 1" wide, 20 gage steel strips. Architect shall approve all insulation details, including methods of fastening, before commencement of the work.

3.05 CLEAN UP AND DISPOSAL

At frequent intervals during and again upon completion of work, remove from building and working premises tools and equipment, surplus materials, all rubbish and debris of whatever nature not caused by other trades, and leave the work in a clean, orderly and acceptable condition approved by the Architect.

END OF SECTION

SECTION 07 25 00

SHEET WEATHER BARRIER

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 SCOPE OF WORK SUMMARY

A. Section Includes:

1. Commercial weather barrier assemblies.
2. Flexible flashing.
3. Weather barrier flashing.
4. Fluid-applied flashing.
5. Weather barrier accessories.
6. Drainage material.

B. Related Requirements:

1. Section 04 22 00 "Architectural Concrete Masonry" for stone masonry ties and flashing installation.
2. Section 07 21 00 "Thermal Insulation" for installation of exterior insulation.
3. Section 07 46 46 "Cementitious Wall Panels" for installation of fiber-cement board siding.
4. Section 09 21 13 "Plaster Assemblies" for installation of stucco.

1.03 DEFINITIONS

A. Weather Barrier: A combination of materials and accessories that do the following:

1. Prevent the accumulation of water as a water-resistive barrier.
2. Minimize the air leakage into or out of the building envelope as a continuous air barrier.
3. Provide sufficient water vapor transmission to enable drying as a vapor-permeable membrane.

B. Water-Resistive Barrier: A combination of materials and accessories that prevent the accumulation of water within the wall assembly per International Building Code Section 1403.2.

C. Continuous Air Barrier: The combination of interconnected materials, assemblies, and sealed joints and components of the building envelope that minimize air leakage into or out of the building envelope per ASHRAE 90.1 section 5.4.3.1.

D. Vapor Diffusion: A slow movement of individual water vapor molecules from regions of higher to lower water vapor concentration (higher to lower vapor pressure).

E. Vapor Permeable Membrane: The property of having a water-vapor permeance rating of 10 perms (575 ng/Pa x s x sq. m) or greater, when tested in accordance with the desiccant method using Procedure A of ASTM E96 per definition in International Building Code. Vapor permeable material permits the passage of moisture vapor through vapor diffusion.

1.04 PREINSTALLATION MEETINGS

A. Preinstallation Conference:

1. Two weeks prior to start of weather barrier installation, meet with Owner, Architect, Manufacturer's Certified Installer, weather barrier manufacturer's designated field representative, and installers of work that interfaces with or affects weather barrier.
2. Review methods and procedures related to weather barrier installation, including manufacturer's written instructions.
3. Review and finalize construction, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine substrate conditions and finishes for compliance with requirements.
5. Review flashings, special weather barrier details, weather barrier penetrations, and condition of other construction that affects weather barrier.
6. Review weather barrier manufacturer's Project Registration and Observation process.
7. Review Construction Indoor Air Quality Management Plan "Moisture Protection for Absorbent Materials."
8. Review temporary protection requirements for weather barrier during and after installation.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For weather barrier, include data on air and water-vapor permeance based on testing in accordance with referenced standards.

B. Shop Drawings: Show details of weather barrier at terminations, openings, and penetrations. Show details of flexible flashing applications.

1.06 INFORMATIONAL SUBMITTALS

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

B. Manufacturer's Instructions: For installation of each product specified.

C. Qualification Data: For Installer

D. Sample Warranty: For manufacturer's warranty.

E. Reports: Field test and inspection reports.

F. Installer's weather barrier manufacturer-training certificate.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is certified by weather barrier system manufacturer to install manufacturer's product.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly, 10 feet by 10 feet, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of weather barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Include junction with roofing membrane at parapet condition, and junction at foundation wall, fenestration, and wall interface.

- b. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply weather barrier until mockups are approved.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
 - C. Manufacturer's Field Service: Register Project with weather barrier manufacturer prior to installation of weather barrier and comply with weather barrier manufacturer's Project registration and observation process.
- 1.08 DELIVERY, STORAGE, AND HANDLING
- A. Do not store near heat source or open flame.
- 1.09 WARRANTY
- A. Manufacturer's Product Warranty: To repair or replace weather barrier product that fails in materials within specified warranty period.
 - 1. Warranty Period: 10 years from date of purchase.
 - B. Manufacturer's Product and Labor Warranty: Manufacturer agrees to repair or replace weather barrier that fails in materials within specified warranty period, including removal and replacement of affected construction up to manufacturer's limits.
 - 1. Warranty Period: 10 years from date of purchase

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Products as manufactured by DuPont Safety & Construction: E.I. du Pont de Nemours and Company.
- B. Source Limitations: Obtain weather barrier assembly components from single manufacturer or from manufacturer approved by weather barrier manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed weather barrier and accessories shall withstand specified wind pressures, liquid water penetration, and water vapor pressures without failure due to defective manufacture of products.
- B. High-Performance Installations:
 - 1. For installation with one of the following building envelope performance or structural characteristics:
 - a. Exceeding 65 mph (100 km/h) equivalent structural load.
 - b. Exceeding 50 mph/6.24 psf (80 km/h) equivalent wind-driven rainwater infiltration.
 - c. Construction with gypsum or cement-based exterior sheathing.
 - d. Non-wood based primary structure such as steel, light gauge steel, masonry, or concrete

2.03 WEATHER BARRIER

- A. Commercial Building Wrap: ASTM E2357 passed, ABAA (Air Barrier Association of America) evaluated air barrier assembly, and assembly water resistance per ASTM E331; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E84; UV stabilized for nine-month exposure; and acceptable to authorities having jurisdiction.
1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont de Nemours, Inc.; Tyvek CommercialWrap and Tyvek CommercialWrap D or Architect approved equal.
 2. System Description, Single-Layer Weather Barrier: Single-layer weather barrier, including flashing and sealing of penetrations and seams.
 3. System Description, Single-Layer Drainable: Single-layer weather barrier with integral drainage, including flashing and sealing of penetrations and seams.
 4. System Description, Double-Layer Drainable: Double-layer weather barrier, including flashing and sealing of penetrations and seams, arranged as follows:
 - a. Primary Layer: Commercial building wrap with integral drainage installed closest to building interior.
 - b. Secondary Layer: Commercial building wrap with integral drainage installed over primary layer.
 5. Drainability:
 - a. 98 percent or greater when tested in accordance with ASTM E2273
 6. Air Permeance, Product: Not more than 0.001 cfm/sq. ft. at 1.57 lbf/sq. ft. (0.005 L/s x sq. m at 75 Pa) when tested in accordance with ASTM E2178.
 7. Air Permeance, Assembly: Not more than 0.04 cfm/sq. ft. at 1.57 lbf/sq. ft. (0.2 L/s x sq. m at 75 PA) when tested in accordance with ASTM E 2357 and evaluated by ABAA.
 8. Water Penetration Resistance, Product: Hydrostatic head resistance greater than 22 inches (55 cm) in accordance with AATCC 127.
 9. Water Penetration Resistance, Assembly: Assembly wall specimen described in ASTM E2357 to water resistance in accordance with ASTM E331 to 2.86 lbf/sq. ft. (137 Pa).
 10. Water-Vapor Permeance: Not less than 23 perms (1300 ng/Pa x s x sq. m) per ASTM E96/E96M, Desiccant Method (Procedure A) or not less than 28 perms (1600 ng/Pa x s x sq. m) per ASTM E96/E96M, Water Method (Procedure B).
 11. Water-Vapor Permeance: Not less than 30 perms (1700 ng/Pa x s x sq. m) per ASTM E96/E96M, Water Method (Procedure B).
 12. Allowable UV Exposure Time: Not less than 9 months (270 days) when tested in accordance with ASTM G155 (Accelerated Weathering).
 13. Flame Propagation Test: Materials and construction shall be as tested in accordance with NFPA 285.
 14. Heat and Visible Smoke Release Rates: Maximum rates in accordance with NFPA 285.
 - a. Peak Heat Release: 13,217 Btu/sq. ft. (150 kW/sq. m).
 - b. Total Heat Release: 1762 Btu/sq. ft. (20 MJ/sq. m)
 - c. Effective Heat of Combustion: 7744 Btu/lbs. (18 MJ/kg)

15. Weather barrier system to have a VOC content of 30 g/L or less.

2.04 WEATHER BARRIER FLASHING

- A. Conformable Weather Barrier Flashing: Composite flashing material composed of micro-creped, polyethylene laminate with a 100 percent butyl-based adhesive layer; AAMA 711 Class A (no primer), Level 3 thermal exposure, 176 deg F (80 deg C) for seven days.
1. Basis-of-Design Product: DuPont de Nemours, Inc.; DuPont™ FlexWrap™ or Architect approved equal.
 2. Conformability: Able to create a seamless sill pan extending up the jambs without cuts, patches, or fasteners.
 3. Water Penetration: No leakage at 15 psf (720 Pa) per ASTM E331.
 4. Low Temperature Adhesion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm) at 25 deg F (minus 4 deg C) as Class A (without primer use).
 5. Adhesion After Water Immersion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm), after AAMA 800, Sections 2.4.1.3.1/2.4.1.4.3, Test B.
- B. Conformable Weather Barrier Flashing for Sealing Penetrations: Composite flashing material composed of micro-creped, polyethylene laminate with a 100 percent butyl-based adhesive layer; AAMA 711 Class A (no primer), Level 3 thermal exposure, 176 deg F (80 deg C) for 7 days.
1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont Safety & Construction: DuPont de Nemours, Inc.; DuPont™ FlexWrap™ EZ or Architect approved equal.
 2. Conformability: Able to create a continuous watertight seal around penetrations from weather barrier to penetration without cuts, patches, or fasteners.
 3. Water Penetration: No leakage at 15 psf (720 Pa) per ASTM E 331.
 4. Low Temperature Adhesion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm) at 25 degrees F (minus 4 deg C) as Class A (without primer use).
 5. Adhesion After Water Immersion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm), after AAMA 800, Sections 2.4.1.3.1/2.4.1.4.3, Test B.
- C. Strip Flashing: Composite flashing material composed of spunbonded polyethylene laminate with 100 percent butyl-based, dual-sided, adhesive layer; AAMA 711, Class A (no primer), Level 3 thermal exposure, 176 deg F (80 deg C) for seven days.
1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont de Nemours, Inc.; DuPont™ StraightFlash™ or Architect approved equal.
 2. Water Penetration: No leakage at 15 psf (720 Pa) per ASTM E331.
 3. Low Temperature Adhesion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm) at 25 deg F (minus 4 deg C) as Class A without primer use.
 4. Adhesion After Water Immersion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm), after AAMA 800, Sections 2.4.1.3.1/2.4.1.4.3, Test B.
- D. Strip Flashing: Composite flashing material composed of spunbonded polyethylene laminate with 100 percent butyl-based, dual-sided, adhesive layer; AAMA 711, Class A (no primer), Level 3 thermal exposure, 176 deg F (80 deg C) for 7 days.
1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont Safety & Construction: DuPont de Nemours, Inc.; DuPont™ VersaFlange™ or Architect approved equal.
 2. Water Penetration: No leakage at 6.24 psf (300 Pa) per ASTM E 331.

3. Low Temperature Adhesion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm) at 25 deg F (minus 4 deg C) as Class A without primer use.
 4. Adhesion After Water Immersion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm), after AAMA 800, Sections 2.4.1.3.1/2.4.1.4.3, Test B.
- E. Strip Flashing: Composite flashing material composed of polypropylene laminate with 100 percent butyl-based, adhesive layer; AAMA 711, Class A (no primer), Level 3 thermal exposure, 176 deg F (80 deg C) for 7 days.
1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont Safety & Construction: DuPont de Nemours, Inc.; DuPont™ Flashing Tape or Architect approved equal.
 2. Water Penetration: No leakage at 6.24 psf (300 Pa) per ASTM E 331.
 3. Low Temperature Adhesion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm) at 25 deg F (minus 4 deg C) as Class A without primer use.
 4. Adhesion After Water Immersion: Exceeds minimum value of 1.5 lb./in. (0.26N/mm), after AAMA 800, Sections 2.4.1.3.1/2.4.1.4.3, Test B.

2.05 FLUID-APPLIED FLASHING

- A. Fluid-Applied Flashing: Trowel or brush applied, non-water soluble, single component, silyl terminated polyether technology (STPE), vapor permeable, flashing material.
1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont de Nemours, Inc.; Tyvek Fluid Applied Flashing & Joint Compound+ or Architect approved equal.
 2. VOC Content: ASTM C1250, less than 2 percent by weight and between 25 to 30 g/L.
 3. Water Vapor Transmission: ASTM E96, Method B, greater than 20 perms (1100 ng/Pa x s x sq. m) at 25 mils (0.635 mm) thick.
 4. Minimum Tensile Strength: ASTM D412, 165 lb/sq. ft. (1140 kPa).
 5. Minimum Elongation at Break: ASTM D412; 380 percent.

2.06 WEATHER BARRIER ACCESSORIES

- A. Building Wrap Tape: Pressure-sensitive plastic tape recommended by weather barrier manufacturer for sealing joints and penetrations in commercial building wrap.
1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont de Nemours, Inc.; Tyvek® Tape or Architect approved equal.
- B. Closed-Cell Polyurethane Foam Insulation: Low-pressure, low-expansion, single-component polyurethane foam, with maximum flame-spread and smoke-developed indexes of 15 and 25, respectively, per ASTM E84.
1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont de Nemours, Inc.; DuPont™ Great Stuff Pro or Architect approved equal.
- C. Fasteners with Self-Gasketing Washers: Commercial building wrap manufacturer's recommended pneumatically or hand-applied fasteners with 2-inch- (50-mm-) diameter, high-density polyethylene cap washers with UV inhibitors.
1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont de Nemours, Inc.; Tyvek® Wrap Caps or Architect approved equal.
- D. Primer for Flashings: Synthetic rubber-based product; spray applied. Strengthen adhesive bond at low temperature applications between weather products such as self-adhered flashing products, commercial building wraps, and common building sheathing materials.

1. Peel Adhesion Test: Passes in accordance with ASTM D3330, Test Method F, for the following.
 - a. Peel Angles: 0, 25, 72, and 180 degrees.
 - b. Substrates: Concrete masonry units (CMUs), exterior gypsum sheathing, oriented strand board (OSB), aluminum, and vinyl.
2. Chemical Compatibility: Pass; AAMA 713.
3. Flame Spread Index: 5; ASTM E84.
4. Smoke Development Index: 0; ASTM E84.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements.
- B. Verify that substrate and surface conditions are in accordance with commercial weather barrier manufacturer recommendations prior to installation.
 1. Verify that rough sill framing for doors and windows is sloped downwards towards the exterior and is level across width of the opening.
- C. Verify that surfaces to receive weather barrier flashing are clean, dry, and free of frost.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Direct water onto an acceptable weather barrier drainage plane with an unobstructed path to exterior of wall.
 1. Provide a drainage path for water intrusion through window and door attachment system that collects at window and door sills and directs water to the exterior or weather barrier.

3.03 COMMERCIAL BUILDING WRAP INSTALLATION

- A. General: Comply with weather barrier manufacturer's written installation guidelines and warranty requirements.
- B. Cover exposed exterior surface of sheathing with weather barrier securely fastened to framing immediately after sheathing is installed.
 1. Maintain continuity of air and water barrier assemblies.
 2. Start weather barrier installation at a building corner, leaving 12 inches (300 mm) of weather barrier extended beyond corner to overlap.
 3. Install weather barrier horizontally starting at lower portion of wall surface.
 4. Provide minimum 6 inches (150 mm) overlap at horizontal- and vertical-wrap seams in a shingle manner to maintain continuous downward drainage plane and air and water barrier.
- C. Seams: Seal seams with building wrap tape per manufacturer's recommended installation instructions.
 1. Shiplap horizontal seams in weather barrier to facilitate proper drainage.
- D. Fasteners: Use weather barrier manufacturer's recommended fasteners to secure weather barrier and install fasteners according to weather barrier manufacturer's installation guidelines.

1. Do not use temporary fasteners to permanently attach weather barrier.
 2. Do not place fasteners with gasketing washers where weather barrier flashing will be installed.
 3. Install fasteners with gasketing washers through flashing where recommended by manufacturer.
- E. Openings: Completely cover openings with weather barrier, then cut weather barrier membrane to openings in accordance with weather barrier manufacturer's installation guidelines.
1. Provide head and jamb flaps and seam overlaps to maintain continuous drainage.
 2. Repair damage to weather barrier using method recommended by weather barrier manufacturer.
 3. Install flashing in accordance with weather barrier manufacturer's installation guidelines.

3.04 WEATHER BARRIER FLASHING INSTALLATION

- A. Installation: Remove wrinkles and bubbles, reposition weather barrier as necessary to produce a uniform, smooth surface.
1. Ensure that ambient and substrate surface temperatures are acceptable in accordance with manufacturer instructions and recommendations.
 2. Wipe surfaces to remove moisture, dirt, grease and other debris that could interfere with adhesion.
 3. Apply weather barrier manufacturer's recommended primer over concrete, masonry, and glass-mat gypsum wall sheathing substrates to receive weather barrier flashing.
 4. Lap weather barrier flashing a minimum of 2 inches (50 mm) onto weather barrier.
 5. Apply pressure over entire surface using roller or firm hand pressure
- B. Rough Openings: Shiplap flashing with weather barrier in a shingle manner to maintain a continuous downward drainage plane and air and water barrier in accordance with manufacturer's written instructions.
1. Apply 6-inch (150-mm) wide (at 4" framing) & 9-inch (230-mm) (at 6" framing) conformable weather barrier flashing at door and window sills.
 2. Ensure that sill flashing does not slope to the interior.
 3. Install backer rod in joint between frame of opening product and flashed rough opening on the interior.
 4. Apply sealant or closed-cell polyurethane foam insulation around entire opening/fenestration product to create air seal around interior perimeter of window openings in accordance with weather barrier manufacturer's instructions.
 5. Around door and window openings, apply butyl-based flashing to flaps of weather barrier.
 6. Use strip flashing with wrap cap screws to secure head flap of the windows.
- C. Penetrations: Apply weather barrier manufacturer's recommended weather barrier flashing patches behind fastening plates, such as brick-tie base plates, metal-flashing clips, and metal channels.
1. Seal weather barrier around each penetration with weather barrier manufacturer's recommended self-adhered flashing product or sealant. Integrate products with flanges into the weather barrier.

D. Terminations: Provide minimum 2 inches (50 mm) overlap using strip flashing on adjoining roof and base of wall systems to maintain continuous downward drainage plane.

1. Secure weather barrier with fasteners and weather barrier flashing.

3.05 FLUID-APPLIED FLASHING INSTALLATION

A. General: Before installing fluid-applied flashing, do the following:

1. Ensure drainage path is not blocked or disrupted. Do not install on walls that do not feature a continuous path for moisture drainage. Blocked or disrupted paths for drainage can result in excess moisture buildup in wall cavity. Do not install below grade.
2. Remove surface dust, dirt, and loose mortar.
3. Verify that surface is free of grease and other contaminants and that surface is smooth.
4. Fill joints in CMUs and voids in cast-in-place concrete with trowel-applied fluid-applied flashing to ensure surface is flush and smooth.
5. Allow masonry mortar and cast-in-place concrete a minimum of 24 hours to cure before installing fluid-applied flashing.

B. Fluid-Applied Flashing Installation: Using a trowel or brush, apply fluid-applied flashing around perimeter of recessed window and door openings to a minimum thickness of 25 mils (0.635 mm).

1. Extend flashing a minimum of 2 inches (50 mm) onto top of transition membrane.
2. Inspect for gaps and pinholes in fluid-applied flashing and apply additional coats until no gaps and pinholes appear.
3. Joint Applications: Using a trowel or a brush, fill cracks and voids up to 1/4 inch (6 mm) in width.
 - a. For joints and cracks between 1/4 and 1/2 inch (6 and 12 mm) wide, cover first with mesh tape.
 - b. For joints and cracks between 1/2 and 1 inch (12 and 24 mm) wide, cover first with butyl-based strip flashing.
 - c. Apply a bead, then trowel smooth.
 - d. Seam coverage should be a minimum of 2 inches (50 mm) wide and 15 to 20 mils (0.38 to 0.51 mm) thick.
 - e. Inspect for gaps and pinholes in fluid-applied flashing and apply additional coats until no gaps and pinholes appear.

3.06 DRAINAGE MATERIAL INSTALLATION

A. Install drainage material with grooves or channels running vertically in compliance with manufacturer's written instructions.

3.07 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to train installers and observe subject test-wall areas and installations.

B. Field Quality Control Testing: Perform the following tests:

1. Air Infiltration Whole Building: ASTM E779 at not more than 0.40 cfm/sf (2.00 L/s per sq. m).

2. Water Penetration: ASTM E1105 at a minimum [**uniform**] [**and**] [**cyclic**] static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 2.86 lbf./sq. ft. (137 Pa). No water penetration shall occur as defined in ASTM E1105.

- a. Perform a minimum of two tests in areas as directed by Architect.
- b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10 and 50 percent completion.

C. Prepare test and inspection reports.

3.08 CLEANING

- A. Immediately remove release paper and scrap from work area and dispose of material in accordance with requirements of Section 01 74 00.

3.09 PROTECTION

A. Protect installed weather barrier from the following:

1. Damage from cladding, structure, or a component of the structure (for example, window, door, or wall system).
2. Contamination from building site chemicals, premature deterioration of building materials, or nonstandard use or application of products.
3. Foreign objects or agents, including the use of materials incompatible with weather barrier products.
4. UV exposure in excess of products' stated limits.

END OF SECTION

SECTION 07 26 16

BELOW-GRADE VAPOR BARRIER

PART 1 – GENERAL

1.01 GENERAL REQUIRMENTS

Division 0, Contract requirements and Division 1, General Conditions apply to this section.

1.02 SCOPE OF WORK SUMMARY

- A. Supply and install all below-grade vapor barriers, as shown on Drawings and as specified herein, including all materials and labor for a timely, complete and proper installation.
- B. Section includes, but is not limited to:
 - 1. Section 02 06 14 and/or Soils Report for subgrade preparation.
 - 2. Section 03 30 00 Cast-in-Place Concrete.

1.03 STANDARDS AND REFERENCES

- A. ASTM D1709 - 09 Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
- B. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- C. ASTM E154 - Standard Test Methods for Water Vapor Barriers Used in Contact with Earth Under Concrete Slabs.
- D. ASTM E1643 - Standard Practice for Installation of Water Vapor Barriers Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- E. ASTM E1745 - Standard Specification for Plastic Water Vapor Barriers Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- F. ASTM F1249-01 Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.

1.04 QUALITY ASSURANCE

- A. Use an experienced installer and adequate number of skilled personnel who are thoroughly trained and experienced in the application of the vapor barrier.
- B. Obtain vapor barrier materials from a single manufacturer regularly engaged in manufacturing the product.
- C. Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).
- D. Pre-Construction Meeting: Convene one week prior to installation of under slab vapor barrier. Attendees to be as follows: - Architect, Engineer, General Contractor, Vapor Barrier Installer, and Vapor Barrier Manufacturer to discuss the application in detail.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

- A. Provide in accordance with Section 01 33 00 Submittal Procedures.
- B. Product Data: Include independent laboratory test results showing compliance with ASTM and ACI Standards. Include manufacturer's installation instructions for placement, seaming, and pipe boot installation.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Comply with the requirements of Section 01 66 00 Product Storage and Handling Requirements.
- B. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- C. Store materials in a clean, dry area in accordance with manufacturer's instructions.
- D. Protect materials during handling and application to prevent damage or contamination
- E. Ensure membrane is stamped with manufacturer's name, product name, and membrane thickness at intervals of no more than 85" (220 cm).

1.08 PROJECT CONDITIONS

Comply with the requirements of Section 01 50 00 Construction Facilities.

1.09 WARRANTY

Provide Manufacturer's Standard Warranty in accordance with Section 01 78 36 Warranties.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Perminator 15 Mil by W.R. Meadows
- B. Stego Wrap 15 Mil Vapor Barrier by Stego Industries
- C. Vapor-Block 15 Mil by Raven Industries
- D. Or Architect approved equal

2.02 MATERIALS

- A. Vapor Barrier must have the following qualities:
 - 1. 15 mil thickness minimum.
 - 2. Permeance of 0.01 UP perms as tested by ASTM E154.
 - 3. Puncture resistance of 2,200 grams per ASTM D1709, Method B.
 - 4. Tensile Strength of 45lbf/inch as per ASTM E1745-17
 - 5. ASTM E 1745 Class A (Plastics) after conditioning testing.
- B. Vapor Barrier Tape:
 - 1. As recommended by Vapor Barrier Manufacturer.
 - 2. Manufactured from High Density Polyethylene.
 - 3. Pressure Sensitive Adhesive.
- C. Pipe Boots: Construct from vapor barrier sheeting material and pressure sensitive tape in accordance with manufacturer's instructions.
- D. Sand: Clean yard sand, free from excessive dirt, debris, organic matter, and fines smaller than No. 200 sieve size.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Below grade and grading work and items penetrating moisture barrier shall be completed prior to start of installation.
- B. Examine the areas and conditions under which work of this Section will be performed.
- C. Correct conditions detrimental to timely and proper completion of the Work.
- D. Do not proceed until unsatisfactory conditions are corrected.
- E. Beginning of installation means acceptance of conditions.

3.02 INSTALLATION REQUIREMENTS

A. Vapor Barrier Sheeting:

- 1. Install in accordance with manufacturer's instructions and ASTM E1643.
- 2. Unroll with the longest dimension parallel with the direction of the pour.
- 3. Lap vapor barrier over footings and seal to foundation walls.
- 4. Overlap joints 6-inches and seal with manufacturer's pressure sensitive tape.
- 5. Seal penetrations, including pipes, with pipe boot.
- 6. Penetrations through vapor barrier sheeting except for reinforcing steel and permanent utilities are not permitted.
- 7. Repair damaged areas by cutting patches of vapor barrier sheeting, overlapping damaged area 6-inches and taping all four sides with pressure sensitive tape.

B. Sand Cushion:

- 1. Provide 2-inch layer over moisture barrier, unless otherwise indicated.
- 2. Spread over surfaces required and work to fill voids; leave in stable condition with finished surfaces reasonably uniform at established grade.

END OF SECTION

SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 SCOPE OF WORK SUMMARY

Furnish materials and perform labor required to execute this work as indicated on the drawings, as specified and as necessary to comply with the Contract Documents, including, but not limited to, these major items:

- A. All metal wall flashings, related flashing, coping and caps.
- B. Flashing at curbed openings, and other miscellaneous areas where indicated on the drawings.
- C. Flashing flanges for roof drains and overflows.
- D. Flashing at parapet walls that receive roofing membrane.
- E. Flashing and metal covers at mechanical equipment platforms.
- F. Gutters and downspouts.
- G. Rain Water Leaders, Collectors and Scuppers.
- H. Shop and field priming, shop painting, galvanizing, screening, caulking, anchors and anchor straps, clips, etc.
- I. Shop drawings of all sheet metal work including expansion joints.

1.03 STANDARDS AND REFERENCES

Comply with the Industry Standards and References as established by Manufacturer.

1.04 QUALITY ASSURANCE

- A. Verify drawing dimensions with actual field conditions. Inspect related work and adjacent surfaces.
- B. Report to the Architect all conditions that prevent proper execution of this work.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

- A. Provide in accordance with Section 01 33 00 Submittal Procedures.
- B. Shop Drawings: submit: all information required for fabrication, finishing and installation of this work in complete details.

1.07 DELIVERY, STORAGE, AND HANDLING

Comply with Section 01 66 00 Product Storage and Handling Requirements.

1.08 PROJECT CONDITIONS

- A. Comply with the requirements of Section 01 50 00 Construction Facilities.
- B. Comply with Manufacturer's Standard Requirements.

1.09 OPERATION AND MAINTENANCE DATA

Provide in accordance with Section 01 77 00 Project Closeout.

1.10 RECORD DRAWINGS

Provide in accordance with Section 01 77 00 Project Closeout.

1.11 WARRANTY

- A. Provide Warranty in accordance with Section 01 78 36 Warranties.
- B. Contractor guarantees the work covered by this specification against all defects in material and workmanship for a period of not less than five (5) years from the date the Owner records Notice of Completion.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Galvanized Sheet Metal: Conform to ASTM A525, thickness indicated or specified, but not less than 24-gauge. Zinc coating shall weigh not less than 1-1/2 ounces, or more than 1-1/2 ounces per square foot of surface covered.
- B. Solder: Standard Grade-A brand of 50:50 Alloy Lead-Tin, complying with ASTM B32. Name of manufacturer and grade designation shall be cast or die-marked on each bar.
- C. Solder Flux: Raw muratic acid for galvanized metal and zinc; resin for tin, lead, and tinned copper; and non-corrosive soldering salts for uncoated copper.
- D. Sheet Metal Fasteners: Rivets, nails, sheet metal screws, self-tapping screws, and stove bolts, of the type and size best adapted to the condition of use. Provide fasteners of the type specified or indicated.
 - 1. Use: galvanized steel, cadmium-plated steel or 300 Series alloy stainless steel.
 - 2. Pop rivets may be used for metal-to-metal connections when future disassembly is not required. Open-end type may be used for all applications except where watertight connections are required, in which case, use closed end type.
- E. Caulking Compound: Provide as specified under Section 07 90 00. Apply as recommended by the manufacturer; caulking compound of proper consistencies for gun and knife application as necessary.
- F. Shop Prime Coat: Rust-Oleum Corporation. Apply #3202 to 1/2 mil wet coating thickness, #3268 to 1-mil dry coating thickness or provide primer as specified under Section 09 90 00.
- G. Shop Color Coat: Pre-coat in shop with coating of color to match adjoining surfaces.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which work of this Section will be performed.
- B. Correct conditions detrimental to timely and proper completion of the Work.
- C. Do not proceed until unsatisfactory conditions are corrected.
- D. Beginning of installation means acceptance of conditions.

3.02 FABRICATION AND ASSEMBLY

- A. Workmanship: Fabricate and finish metal work in a first class manner in accordance with best trade practices with all joints and corners accurately machined, filed and fitted, and rigidly framed together and connected. Carefully match components to produce perfect continuity of line and design. Make joints and connections in exterior face metal watertight, using approved scaling materials and methods of assembly. Fit faces of metal in contact with hairline joints, except as otherwise indicated or required for expansion or fitting. Conceal fastenings, unless otherwise indicated. Conceal required reinforcements within the finished assembly.
- B. Expansion and Contraction: Form and fabricate work to adequately provide for thermal expansion and contraction and building movement in the completed work, without over-stressing the materials, breaking connections, or producing wrinkles and distortion in finished surfaces. Finish sheet metal work water and weathertight throughout.
- C. Attachment Clips: Where subject to thermal expansion and contraction, attach members with clips to permit movement without damage to the installation, or provide slotted or over-size holes with washers where appearance is not critical, as approved by the Architect.
- D. Lock Seams: Make lock seam work flat and true to line; sweat full of solder except where installed to permit expansion and contraction. Lap flat lock seams, and lap seams where soldered, according to pitch but in no case less than 4". Make seams in direction of flow. Fill expansion joints with sealant. Plane surfaces shall be free of buckles. Provide reinforcement as necessary. Cleat and fasten substantially on approximately eight-inch centers. All cap flashing and gutter seams to be flat lock seams.
- E. Soldering: Thoroughly clean and tin material prior to soldering. Solder with heavy coppers of blunt design, properly tinned before use. For flat seam work they shall not weight less than ten pounds per pair, and for other work not less than size pounds per pair. Solder slowly with well-heated coppers, heating the seams thoroughly and completely filling them with solder. Finish surfaces neatly, full flowing and smooth. Wash acid flux thoroughly with a soda solution after soldering and completely remove soldering flux on exposed surfaces.
- F. Welding: Conform to the requirements of AWS "Standard Code for Arc and Gas Welding". Perform welding in a manner resulting in strong, durable, tight, flush, smooth, and clean joints. Weld sheet steel to produce full and complete fusion welds without inducing locked-in stresses in the metal or surface distortions. Welding on exposed surfaces shall be ground smooth and flush and finished to match adjacent surfaces.
- G. Caulking: Where indicated, caulk joints in sheet metal work and between sheet metal work and adjacent construction with polysulfide sealing compound. Apply in accordance with Caulking and Sealants Section.
- H. Coping: Shall be attached to top of parapets in strict conformance with the latest written specifications of the Sheet Metal Industry Fund of Los Angeles, and as indicated on the drawings.
- I. All sheet metal work shall be examined carefully the Contractor, Owner and Architect and if necessary, tested. The Contractor shall make all repairs to damaged items as a result of this testing, leaving them in a condition satisfactory to the Architect.

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 SCOPE OF WORK SUMMARY

A. Section Includes:

1. Through Penetration Firestopping.
2. Fire Resistive Joint Systems.

1.03 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI/UL 263 - Fire Tests of Building Construction and Materials.
2. ANSI/UL 723 - Surface Burning Characteristics of Building Materials.
3. ANSI/UL 1479 - Standard for Fire Tests of Through-Penetration Firestops.
4. ANSI/UL 2079 - Tests for Fire Resistance of Building Joint Systems.

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

1. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E 814 - Standard Test Method for Fire Tests of Through-Penetration Firestops.
4. ASTM E 1399 - Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.
5. ASTM E 1966 - Standard Test Method for Fire Resistive Joint Systems.
6. ASTM E 2174 - Standard Practice for On-Site Inspection of Installed Firestops.
7. ASTM E 2307 - Fire Tests of Perimeter Fire Barrier Systems Using Intermediate Scale, Multi-Story Test Apparatus.
8. ASTM E 2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

C. Factory Mutual (FM) - FM4991 - Standard for Approval of Firestop Contractors.

D. International Code Congress (ICC):

1. International Building Code (IBC).
2. International Residential Code (IRC).
3. International Mechanical Code (IMC)
4. International Fire Code (IFC)
5. International Code Congress Evaluation Service (ICC ES)

E. National Fire Protection Association (NFPA):

1. NFPA 70 - National Electrical Code.

2. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
 3. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
 4. NFPA 101 - Life Safety Code.
 5. NFPA 5000 - Building Construction and Safety Code.
- F. Underwriters Laboratories (UL) - UL Building Materials Directory:
1. Through-Penetration Firestops Systems (XHEZ).
 2. Joint Systems (XHBN).
 3. Firestop Devices (XHJI).
 4. Forming Materials (XHKU).
 5. Wall Opening Protective Materials (CLIV).
 6. Fill, Void or Cavity Materials (XHHW).
- G. American Society of Sanitary Engineering (ASSE):
1. ASSE Series 9000 – Professional Qualification Standard for Firestop Systems and Device Installers, Inspectors and Surveyors.
- H. International Association of Plumbing and Mechanical Officials (IAPMO):
1. Uniform Plumbing Code (UPC).
 2. Uniform Mechanical Code (UMC).
- I. International Standards Organization (ISO):
1. ISO 6944
 2. ISO 10295-1: 2007.
 3. ISO 10295-2: 2009.
 4. ISO 10295-3:

1.04 PERFORMANCE REQUIREMENTS

- A. Provide systems that are listed by at least one the following:
1. Underwriters Laboratories Inc. (UL), in "Fire Resistance Directory".
 2. Intertek Testing Service (Formerly known as Omega Point Laboratories), in "Directory of Listed Products".
 3. Factory Mutual (FM), in FMRC Approval Guide.
 4. Any other qualified independent testing and inspection agency that conducts periodic follow-up inspections and is acceptable to authorities having jurisdiction.
- B. Provide firestop products that are flexible enough to allow for pipe vibration in a through penetration application.
- C. Provide fire resistive sealants and sprays for construction joint applications that are flexible enough to satisfy the movement criteria per the test standards ASTM E 1399, ASTM E 1966 or ANSI/UL 2079.
- D. Provide products with the appropriate flame spread index and smoke develop index, when tested in accordance with ASTM E 84.
- E. Provide products that meet the intent of the L rating classification for the movement of smoke per ANSI/UL 1479 for through penetrations and ANSI/UL 2079 for construction joints.
- F. Provide products identical to those tested and listed for classification by UL, Intertek or any other qualified independent testing agency.

- G. Provide products that bear classification marking of qualified independent testing agency.
- H. Where firestop systems not listed by any listing agency are required due to project conditions, submit a substitution proposal with evidence specified.
- I. Use only products specifically listed for use in listed systems.
- J. Provide products that are compatible with each other, with the substrates forming openings, and with the items, if any, penetrating the firestopping, under the conditions represented by this project, based on testing and field performance demonstrated by manufacturer.
- K. Firestopping materials must meet and be acceptable for use by all building codes and NFPA codes cited in this section.
- L. Provide products that meet the intent of the state or local guidelines on volatile organic compounds (VOC).
- M. Where applicable provide products that meet the intent of the F rating classification for passage of flame per ANSI/UL 1479 for through penetrations.
- N. Where applicable provide products that meet the intent of the T rating classification for the transfer of temperature per ANSI/UL 1479 for through penetrations.
- O. Provide products that meet the intent of the L rating classification for the movement of smoke per ANSI/UL 1479 for through penetrations and ANSI/UL 2079 for construction joints.
- P. Where applicable provide products that meet the intent of the W rating classification for passage of water per ANSI/UL 1479 for through penetrations.

1.05 SUBMITTALS

- A. Submit under provisions of the Contract and Division 01 – General Requirements.
- B. Shop Drawings: For each firestopping system, provide the following:
 - 1. Listing agency's detailed drawing showing opening, penetrating item(s), and firestopping materials, identified with listing agency's name and number or designation and fire rating achieved.
 - 2. For proposed systems that do not conform strictly to the listing, submit written instructions showing modifications and approved by firestop system manufacturer.
 - 3. Submit under provisions of the International Building Code (IBC) section 107 and 703 requiring a submittal package for fire-resistance ratings and fire tests.
- C. Product Certificates: Submit certificates of conformance signed by firestop system manufacturer certifying that materials furnished comply with requirements.
- D. Product Data: Furnish manufacturer's product data sheets on each material to be used in firestop systems. Information on manufacturer's product data sheet should include:
 - 1. Product characteristics including compliance with appropriate ASTM/UL/ANSI test standards.
 - 2. Storage and handling requirements and recommendations.
- E. Installation Instruction: Furnish manufacturer's installation instructions.
- F. Sustainable or LEED Submittals:
 - 1. VOC Content: For sealants and sealant primers, furnish documentation of VOC content.

1.06 QUALITY ASSURANCE

- A. General: All through-penetration firestop systems and construction gap fire resistive systems shall be installed with approved methods using materials that have been tested and classified to produce an approved assembly.
- B. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of twenty-five (25) years' experience.

1. Products shall be manufactured in a facility that follows ISO 9001 best practices.
- C. Installer Qualifications: Firm must be qualified by having experience, staff, and be properly trained to install the specified products, and meets the following criteria:
 1. Contractor is a 3M Master Contractor.
 2. Contractor is a Certified 3M Trained contractor.
 3. Contractor is acceptable to manufacturer.
 4. Contractor is acceptable to Authority Having Jurisdiction (AHJ).
 5. Contractor has completed the manufacturer's certified product installation training.
 6. Contractor must provide a list of completed projects as evidence of experience; include project name and address, owner's name and address, and architect's name and phone number.
 7. Certificate: Contractor should provide certificate of qualification.
- D. Codes: Where manufacturer's application procedures are in conflict with those of the local Authority Having Jurisdiction, the more strict guidelines will prevail.
- E. Pre-installation Meetings: Meetings to agree on firestop requirements, conditions, manufacturer's instructions.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products until ready for installation in manufacturer's original unopened packaging, legibly marked with manufacturer's name and product identification, date of manufacture, lot number, listing agency's classification marking, curing/dry time, mixing instructions (if applicable) and MSDS reference number.
- B. Store and handle in such a manner as to prevent deterioration or damage due to moisture, temperature changes, contaminants, and other causes; follow manufacturer's instructions.
- C. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local Authority Having Jurisdiction.

1.08 PROJECT CONDITIONS

- A. Coordinate construction and cutting of openings so that each particular firestop system may be installed in accordance with its listing, including assembly rating, L rating, sizing, sleeves, manufacturer's published STC rating and penetrating items.
- B. Coordinate firestopping of dynamic and static construction joints (top-of-wall, bottom-of-wall, floor-to-floor, floor-to-wall), wall-to-wall, perimeter so that each particular system may be installed in accordance with its listing, including assembly rating, sizing, movement capabilities and manufacturer's published STC rating.
- C. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install firestopping under environmental conditions outside manufacturer's absolute limits.
- D. Provide ventilation as required by firestopping manufacturer, including mechanical ventilation if required.

1.09 WARRANTY

- A. At project closeout, provide to Owner or Owners Representative an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 PRODUCTS

1.01 MANUFACTURERS

- A. Basis of Design Manufacturer: 3M Fire Protection Products, which is located at: 3M Center Bldg. 223-2N-21; St. Paul, MN 55144-1000; Toll Free Tel: 800-328-1687; Web: www.3m.com/firestop
 - 1. Acceptable alternates:
 - a. Hilti Inc. Plano, TX., 1-800-879-8000, www.us.hilti.com
 - b. Owens Corning Thermafiber, 1-800-294-7076, www.thermafiber.com.
- B. Single Source: To maintain control and integrity of the firestop applications a single manufacturer should be used. Specific UL or approved listing agencies systems applicable to each type of firestop condition should be supplied by one manufacturer.

1.02 SCOPE/APPLICATION

- A. Provide installed firestop products that limit the spread of fire, heat, smoke, and gasses through otherwise unprotected openings in rated assemblies, including walls, partitions, floors, roof/ceilings, and similar locations, restoring the integrity of the fire rated construction to its original fire rating.
- B. Provide firestop systems listed for the specific combination of fire-rated construction, type of penetrating item, annular space requirements, and fire rating, and the following criteria:
 - 1. F-Rating: Equal to or greater than the fire-resistance rating of the assembly in which the firestopping will be installed.
 - 2. T-Rating: In habitable areas where penetrating items are exposed to potential contact with materials on fire side(s) of rated assembly, T-rating must equal its F-rating.
 - 3. L-Rating: L-rating of 1 cfm per linear foot (5.5 cu m/h/m) maximum at ambient temperatures.
 - 4. W-Rating: meets UL Water Leakage Test, W Rating – Class 1 requirements for systems tested and listed in accordance with ANSI/UL 1479.
 - 5. Wall Penetrations: Through penetration systems must be symmetrical, with the same rating from both sides of the wall. Membrane penetrations may be asymmetrical.
 - 6. Testing: Determine ratings in accordance with ASTM E 814 or UL 1479.
- C. Provide fire-resistive systems listed for construction gaps per the specific combination of fire-rated construction type, configuration, gap dimensions, and fire rating, and the following criteria:
 - 1. Fire resistance rating must be equal to or greater than that of the assembly in which it is to be installed.
 - 2. Movement capability must be appropriate to the potential movement of the gap, demonstrated by testing in accordance with ASTM E 1399/ASTM E 1966/UL 2079 for minimum of 500 cycles at 10 cycles per minute.
 - 3. L-Rating: L-rating of 1 cfm per linear foot (5.5 cu m/h/m) maximum.
 - 4. Determine ratings in accordance with ASTM E 1966/UL 2079.

1.03 THROUGH PENETRATION FIRESTOP PRODUCTS

- A. 3M Fire Barrier Cast-in-Place Devices: Firestopping device for use prior to a concrete pour. Adjustable height with pull tabs, straight edge design for close placement to walls and adjacent devices.
 - 1. Fire Resistance: For use in 1-, 2-, or 3-hour fire-rated systems.
 - 2. Locations: Horizontal assemblies only.
- B. 3M Fire Barrier Ultra RC Pack: One piece metal collar assembly encasing intumescent material for firestopping of pipes and cables through rated walls and floors.
 - 1. Fire Resistance: For use in 1- or 2-hour fire-rated systems.
 - 2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

- C. 3M Fire Barrier Ultra Plastic Pipe Device: Intumescent device for firestopping of plastic pipe and cables through rated walls and floors.
 - 1. Fire Resistance: For use in 1-, 2- or 3-hour fire-rated systems.
 - 2. Configuration: One-piece metal collar, with locking latch and bendable tabs to secure; equipped also for conventional anchoring.
 - 3. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- D. 3M Fire Barrier RC-1 Restricting Collar with either FS 195+ Wrap Strip or 3M Interam Ultra GS Wrap Strip. (See product descriptions below): For firestopping of plastic pipes from 4 inches (102 mm) to 10 inches (254mm) in diameter.
 - 1. Fire Resistance: For use in 1 or 2-hour fire-rated systems.
 - 2. Material: 28-gauge steel.
 - 3. Size: 25-foot (7.6 m) roll.
 - 4. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- E. 3M Fire Barrier CP25WB+ Sealant: High-performance, intumescent, water-based sealant. No-sag, fast drying, paintable, red in color. Versatile firestop sealant for pipes (not for use with CPVC), cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products.
 - 1. Fire Resistance: For use in 1-, 2-, 3- or 4-hour fire-rated systems.
 - 2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
 - 3. STC rating of 54 when tested in STC 54-rated wall assembly.
- F. 3M Fire Barrier IC 15WB+ Sealant: General-purpose, intumescent, water-based sealant. No-sag, fast drying, paintable, yellow in color. Economical firestop sealant for pipes, cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products.
 - 1. Fire Resistance: For use in 1-, 2- or 3-hour fire-rated systems.
 - 2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
 - 3. STC rating of 54 when tested in STC 54-rated wall assembly.
- G. 3M Fire Barrier Sealant FD 150+: Single-part, water-based, acrylic latex sealant. No-sag, low-shrinkage, low VOC. Blue, red or limestone color. Used to firestop for pipe penetrations (not for use with CPVC).
 - 1. Fire Resistance: For use in 1-, 2- or 3-hour fire-rated systems.
 - 2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
 - 3. STC rating of 54 when tested in STC 54-rated wall assembly.
- H. 3M Fire Barrier Water Tight Sealant 3000 WT: Single-part, water-tight, intumescent silicone firestop sealant for filling voids in concrete gypsum, metal, plastic, wood and insulation. Light gray color with black flecks. Meets UL Water Leakage Test, W Rating – Class 1 requirements.
 - 1. Fire Resistance: For use in 1-, 2-, 3- or 4-hour fire-rated systems.
 - 2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
 - 3. STC rating of 53 when tested in STC 54-rated wall assembly.
- I. 3M Fire Barrier Water Tight 1000 NS Sealant: Single-part, non-slump firestopping silicone sealant for floor and wall openings. Light gray color. Meets UL Water Leakage Test, W Rating – Class 1 requirements.
 - 1. Fire Resistance: For use in 1-, 2- or 3-hour fire-rated systems.
 - 2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

3. STC rating of 56 when tested in STC 56-rated wall assembly.
- J. 3M Fire Barrier Water Tight Sealant 1003 SL: Single-part, self-leveling firestopping silicone sealant for floor openings. Light gray color. Meets UL Water Leakage Test, W Rating – Class 1 requirements.
1. Fire Resistance: For use in 1-, 2- or 3-hour fire-rated systems.
 2. Locations: For horizontal assemblies only.
 3. STC rating of 56 when tested in STC 56-rated wall assembly.
- K. 3M Fire Barrier Sealant 2000 NS: Single-part, non-slump elastomeric silicone firestop sealant. Sag-resistant, low VOC. Light grey color. Used in mechanical, electrical and plumbing applications to firestop openings and penetrations through fire-rated floor or wall assemblies. Typical penetrants include: metallic pipe, non-metallic pipe (FGG/BM system CPVC compatible), conduit, power and communication cable and telephone or electrical wiring.
1. Fire Resistance: For use in 1-, 2-, 3- or 4-hour fire-rated systems.
 2. Locations: Vertical and horizontal assemblies.
 3. STC-Rating of 56 when tested in STC 56-rated wall assembly.
- L. 3M Fire Barrier Sealant 2000+: Single-part, elastomeric silicone firestop sealant. Sag-resistant, low VOC. Light grey color. Used in mechanical, electrical and plumbing applications to firestop openings and penetrations through fire-rated floor or wall assemblies. Typical penetrants include: metallic pipe, non-metallic pipe (FGG/BM system CPVC compatible), conduit, power and communication cable and telephone or electrical wiring.
1. Fire Resistance: For use in 1-, 2-, 3- or 4-hour fire-rated systems.
 2. Locations: Vertical and horizontal assemblies.
 3. STC-Rating of 56 when tested in STC 56-rated wall assembly.
- M. 3M Fire Barrier Moldable Putty+: One-part, 100 percent solids intumescent firestop. Remains pliable, flexible and easily re-enterable. Non-toxic synthetic formula. Versatile putty for pipes, cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products.
1. Type: Stick or Pad
 2. Fire Resistance: For use in 1-, 2- or 3-hour fire-rated systems.
 3. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- N. 3M Fire Barrier 2001 Silicone RTV Foam: Two-part, liquid-silicone elastomer, foams in place when mixed. For use sealing large or complex openings such as cable bundles, cable trays and conduit banks.
1. Fire Resistance: For use in 1-, 2- or 3-hour fire-rated systems.
 2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- O. 3M Fire Barrier Mortar: For sealing openings in concrete and masonry walls and floors. Self-Leveling, non-sag, low VOC.
1. Fire Resistance: For use in 1-, 2- or 3-hour fire-rated systems.
 2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- P. 3M Fire Barrier Self-Locking Pillow: Self-contained, intumescent firestop pillow with interlocking strips. Meets fire rating without the use of wire mesh. For use in firestopping larger openings
1. Fire Resistance: For use in 1-, 2- or 3-hour fire-rated systems.
 2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- Q. 3M Fire Barrier Pillow: Self-contained, intumescent firestop product. Meets fire rating without the use of wire mesh. For use in firestopping larger openings

1. Fire Resistance: For use in 1-, 2- or 3-hour fire-rated systems.
 2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- R. 3M Fire Barrier CS-195+ Composite Sheet: Organic/inorganic intumescent elastomeric sheet, bonded on one side to a layer of 28-gauge galvanized steel. Other side reinforced with steel-wire mesh and covered with aluminum foil. Re-enterable. For use in firestopping larger openings
1. Thickness: Nominal 0.3 inch (7.6 mm).
 2. Thermal Expansion: 8 - 10 times original size.
 3. Tensile Strength (ASTM D412): 93.6 psi (645 kPa)/489 percent.
 4. Fire Resistance: For use in 1-, 2-, 3- or 4-hour fire-rated systems.
 5. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- S. 3M Interam Ultra GS Wrap Strip: Graphite based, flexible, largely inorganic, intumescent mat. For use around non-metallic piping with or with RC-1 collar.
1. Fire Resistance: For use in 1-, 2- or 3-hour fire rated systems.
 2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- T. 3M Fire Barrier FS-195+ Wrap/Strip: One-part, organic/inorganic intumescent strip with foil on one side. May be cut to fit irregular shapes. For use around non-metallic piping with or with RC-1 collar.
1. Length: 24 inch (610 mm).
 2. Width: 1 or 2 inches.
 3. Fire Resistance: For use in 1-, 2-, 3- or 4-hour fire-rated systems.
 4. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- U. 3M Fire Barrier Pass-Through Devices: One-Piece device for firestopping of cable penetrations through rated walls and floors.
1. Fire Resistance: For use in 1-, 2- or 3-hour fire-rated systems.
 2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- V. 3M Fire Barrier Tuck-In: Graphite-based, flexible, intumescent wrap strip for use around non-metallic piping. Adhesive closure tab.
1. Fire Resistance: For use in 1-, 2- or 3-hour fire-rated systems.
 2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- W. 3M Fire Barrier Putty Sleeve Kit: Device used for firestopping of cable penetrations through fire rated walls and floors.
1. Fire Resistance: For use in 1-, 2-, 3- or 4-hour fire-rated systems.
 2. Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

1.04 FIRE RESISTIVE JOINT PRODUCTS

- A. 3M Fire Barrier Sealant FD 150+: Single-part, water-based sealant. Sag-resistant, low-shrinkage, low VOC.
1. Fire Resistance: For use in 1-, 2-, 3- or 4-hour fire-rated systems.
 2. Location: For use at top-of-wall, bottom-of-wall, wall-to-wall and floor-to-floor.
 3. Compression/Extension Recovery: +/- 19 percent of original joint width.
 4. Meets optional L rating requirements.
 5. STC rating of 56 when tested in STC 56-rated wall assembly.

- B. 3M Fire Barrier Water Tight Sealant 1000 NS: Single-part, non-slump elastomeric silicone sealant. Sag-resistant, low VOC.
1. Fire Resistance: For use in 1-, 2-, 3- or 4-hour fire rated systems.
 2. Meets UL Water Leakage Test, W Rating – Class 1 requirements.
 3. Location: For use at top-of-wall, bottom-of-wall, wall-to-wall, floor-to-floor, floor-to-wall and perimeter joints.
 4. Compression/Extension Recovery: +/- 15 percent of original joint width.
 5. STC-Rating of 56 when tested in STC-56-rated wall assembly.
- C. 3M Fire Barrier Water Tight Sealant 1003 SL: Single-part, self-leveling elastomeric silicone sealant. Sag-resistant, low VOC.
1. Fire Resistance: For use in 1-, 2-, 3- or 4-hour fire rated systems.
 2. Meets UL Water Leakage Test, W Rating – Class 1 requirements.
 3. Location: For use at top-of-wall, bottom-of-wall, floor-to-wall and floor-to-floor joints.
 4. Compression/Extension Recovery: +/- 15 percent of original joint width.
 5. STC-Rating of 56 when tested in STC-56-rated wall assembly.
- D. 3M Fire Barrier Sealant 2000 NS: Single-part, non-slump elastomeric silicone sealant. Sag-resistant, low VOC.
1. Fire Resistance: For use in 1-, 2-, 3- or 4-hour fire rated systems.
 2. Service Flexibility: Accommodate vibration from normal building movement.
 3. Location: For use at top-of-wall, bottom-of-wall, wall-to-wall, floor-to-wall, floor-to-floor and perimeter joints.
 4. Compression/Extension Recovery: +/- 31 percent of original joint width.
 5. STC-Rating of 56 when tested in STC 56-rated wall assembly.
- E. 3M Fire Barrier Sealant 2000+: Silicone Sealant: Single-part, elastomeric silicone sealant. Sag-resistant, low VOC.
1. Fire Resistance: For use in 1-, 2-, 3- or 4-hour fire rated systems.
 2. Compression/Extension Recovery: +/- 13 percent of original joint width.
 3. Location: For use at top-of-wall, bottom-of-wall, wall-to-wall, floor-to-wall and floor-to-floor joints.
- F. 3M FireDam Spray 200: Water-based, paintable, low VOC, freeze/thaw resistant spray applied fire resistive product. Applied with conventional airless spray equipment.
1. Fire Resistance: For use in 1-, 2-, 3- or 4-hour fire rated systems.
 2. Compression/Extension Recovery: +/- 50 percent of joint width.
 3. Location: For use at head-of-wall, wall-to-wall, floor-to-floor, bottom-of-wall, floor-to-wall and perimeter joints.
 4. STC-Rating of 56 when tested in STC 56-rated wall assembly.

1.05 FIRESTOPPING FOR SINGLE MEMBRANE PENETRATIONS

- A. 3M Fire Barrier Moldable Putty+: One-part, 100 percent solids intumescent firestop. Remains pliable, flexible and easily re-enterable. Non-toxic synthetic formula.
1. Type: Pad.
 2. Fire Resistance: For use in 1-, 2- or 3-hour fire rated systems.
- B. 3M Endothermic Mat E-5A-4: Endothermic heat absorbing mat.

1. Type: Mat.
2. Fire Resistance: For use in 1- or 2-hour fire rated systems.

PART 3 EXECUTION

1.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Conduct tests according to manufacturer's written recommendations to verify that substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt and other foreign substances capable of impairing bond of firestopping.
- C. Verify that items penetrating fire rated assemblies are securely attached, including sleeves, supports, hangers, and clips.
- D. Verify that openings and adjacent areas are not obstructed by construction that would interfere with installation of firestopping, including ducts, piping, equipment, and other suspended construction.
- E. Verify that environmental conditions are safe and suitable for installation of firestopping.
- F. If substrate preparation is the responsibility of another installer, notify Architect or Engineer of Record of unsatisfactory preparation before proceeding.

1.02 PREPARATION

- A. Prepare substrates in accordance with manufacturer's instructions and recommendations.
- B. Install masking and temporary coverings as required to prevent contamination or defacement of adjacent surfaces due to firestopping installation.

1.03 INSTALLATION

- A. Install in strict accordance with manufacturer's detailed installation instructions and procedures.
- B. Install so that openings are completely filled and material is securely adhered.
- C. Where firestopping surface will be exposed to view, finish to a smooth, uniform surface flush with adjacent surfaces.
- D. After installation is complete, remove combustible forming materials and accessories that are not part of the listed system.
- E. Repair or replace defective installations in accordance with manufacturer's recommendations, listed systems details and applicable code requirements.
- F. At each through penetration or fire-resistive joint system, attach identification labels on both sides in location where label will be visible to anyone seeking to remove penetrating items or firestopping.
- G. Clean firestop materials off surfaces adjacent to openings as work progresses, using methods and cleaning materials approved in writing by firestop system manufacturer and which will not damage the surfaces being cleaned.
- H. Notify Authority Having Jurisdiction when firestopping installation is ready for inspection; obtain advance approval of anticipated inspection dates and phasing, if any, required to allow subsequent construction to proceed.
- I. Do not cover firestopping with other construction until approval of authority having jurisdiction has been received.

1.04 FIELD QUALITY CONTROL

- A. Owner will engage an independent testing agency to inspect installed firestopping and to prepare reports indicating whether the installed work complies with the contract documents.

- B. Notify testing agency at least 7 days prior to date when firestopping installation will be ready for inspection; obtain advance approval of general schedule and phasing, if any, required to allow subsequent construction to proceed.

1.05 CLEANING AND PROTECTION

- A. Remove left over material and debris from Work area. Use necessary means to protect fire protection product(s) before, during, and after installation.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. Install identification Labels for Through Penetration and Construction Joint Systems: Pressure sensitive self-adhesive vinyl labels, preprinted with the following information:
 - 1. The applicable words "Warning - Through Penetration Firestop System - Do not Disturb. Notify Building Management of Any Damage." or "Warning – Construction Gap Fire Resistive System - Do not Disturb. Notify Building Management of Any Damage."
 - 2. Listing agency's system number or designation.
 - 3. System manufacturer's name, address, and phone number.
 - 4. Installer's name, address, and phone number.
 - 5. General contractor's name, address, and phone number (if applicable).
 - 6. Date of installation.

END OF SECTION

SECTION 07 90 00

JOINT PROTECTION

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Requirements apply to this Section.

1.02 SCOPE OF WORK

Work included: Throughout the work, seal and caulk joints where shown on the Drawings and elsewhere as required to provide a positive barrier against passage of moisture and passage of air.

1.03 STANDARDS AND REFERENCES

Comply with the Industry Standards and References as established by Manufacturer.

1.04 QUALITY ASSURANCE

- A. Conform to Sealant and Waterproofers Institute requirements for materials and installation.
- B. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.
- C. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

- A. Provide in accordance with Section 01 33 00 Submittal Procedures.
- B. Submit product data:
 - 1. For each sealant product indicated provide manufacturer's technical data, tested physical and performance properties, dimensioned drawings, and other data needed to prove compliance with the specified requirements.
 - 2. Manufacturer's recommended installation procedures which, when accepted by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the Work.
- C. Samples:
 - 1. Samples for Initial Selection: Three color charts showing manufacturer's standard range of colors available for each product exposed to view.
 - 2. Samples for Verification: Three strips of cured sealants 1/2 inch by 6 inch (13mm diameter by 150 mm).

1.07 DELIVERY, STORAGE AND HANDLING

- A. Comply with Section 01 66 00 Product Storage and Handling Requirements.
- B. Deliver products in original factory packaging bearing identification of product, manufacturer, and batch number. Provide Safety Data Sheets for each products.
- C. Store products in a location from freezing, damage, construction activity, precipitation, and direct sunlight per manufacturer's recommendations.
- D. Condition products to approximately 60 degrees F (16 degrees C) to 70 degrees F (21

degrees C) for use per manufacturer's recommendations.

E. Handle products with appropriate precautions and care as stated on Safety Data Sheet.

1.08 PROJECT CONDITIONS

A. Comply with the requirements of Section 01 50 00 Construction Facilities

B. Do not use products under conditions of precipitation, or in inclement or freezing weather. Verify that substrates are clean, dry and frost-free. Use appropriate measures for protection and supplementary heating to ensure proper curing conditions per manufacturer's recommendations if application during inclement weather occurs.

1.09 OPERATION AND MAINTENANCE DATA

Provide in accordance with 01 77 00 Project Closeout.

1.10 WARRANTY

A. Provide Manufacturer's Standard Warranty in accordance with Section 01 78 36 Warranties.

B. Warranties listed in this Section shall be in addition to, and not a limitation of other rights the owner may have under the contract documents.

C. The guarantee specified herein shall include warranties against leakage, hardening, cracking, crumbling, melting, running, shrinking or staining adjacent surfaces.

D. Contractor Guarantee: Contractor guarantees the work covered by this specification against all defects in material and workmanship for a period of not less than five (5) years from the date of Substantial Completion.

PART 2 – PRODUCTS

2.01 SEALANTS

A. Except as specifically otherwise accepted by the Architect, use only the types of sealants described as follows:

1. One component polyurethane sealant, moisture curing, low modulus, FS TT-S-0023OC, Type II, Class A, ASTM-C-920, Class 50, for vertical and horizontal joints in connection with all building materials. Do not use in traffic areas. Minimum 1/4" joint; maximum 1-1/4" x 3/8"d.
 - a. Dymonic 100 by Tremco
 - b. MasterSeal NP1 by BASF Master Builders
 - c. DynaTrol I-XL Hybrid by Pecora Corporation
2. One-part silicone sealant, moisture curing, low modulus, FS TT-S-0023OC, Type II, Class A, FS TT-S-001543A, Class A, for vertical and horizontal joints in connection with aluminum, glass and concrete materials which require greater movement capabilities. Do not use in traffic areas. Minimum joint 1/4" x 3/16"d; maximum 1" x 1/2"d.
 - a. Spectrem 1 by Tremco
 - b. Dowsil 790 by Dow
 - c. 890NST Silicone by Pecora Corporation
3. One-part silicone sealant, medium modulus, neutral cure, FS S-0023OC, Type II, Class A, FS TT-S-001543A, Type II, Class A, ASTM C920, Class 50, for vertical and horizontal joints in connection with non-porous surfaces such as aluminum, glass, tile, laminated plastic and concrete. Do not use in traffic areas.

- a. Spectrem 2 by Tremco
 - b. Dowsil 795 by Dow
 - c. 895NST Silicone by Pecora Corporation
- 4. Multi-Component polyurethane sealant, FS TT-S-00227E, Type I, Class A, ASTM C920 for horizontal joints in traffic areas. Minimum 3/8" wide, depth to be 3/8" to 1/2" - use primer.
 - a. DynaTrol II-SG or Dynatred by Pecora Corporation
- 5. One-part translucent silicone sealant, medium modulus, neutral curing, FS TT-S-0023OC, Type II, Class A, FS TT-S-001543A, Type II, Class A, for vertical joints in connection with butt glazing.
 - a. Spectrem 2 by Tremco
 - b. 895 NST by Pecora
 - c. SCS2800 Silglaze II by Momentive
- 6. One-part mildew resistant silicone sealant meeting requirements of FDA Regulation 21 CFR 177.2600, for vertical and horizontal joints in connection with non-porous applications as sealing around bathroom fixtures, shower-tub enclosures, sinks and urinals.
 - a. Trensil 200 by Tremco
 - b. Dowsil 786 by Dow
 - c. SCS1700 Sanitary by Momentive
 - d. 898NST Silicone or 860 Silicone by Pecora Corporation
- 7. One-part siliconized acrylic latex polymer caulk, ASTM C834, for interior horizontal and vertical joints in connection with window and door buck perimeters, interior wall surfaces, etc.
 - a. Tremflex 834 by Tremco
 - b. TremGlaze SA1100 by Tremco
 - c. AC-20 + Silicone by Pecora
- 8. Security Sealants
 - a. One part, non-sag, tamper resistant security sealant, FS TT-S-00230C, Type II, Class B, ASTM C920 for doors and windows.
 - i. DynaFlex SC by Pecora
 - ii. MasterSeal CR 195 by BASF Master Builders.
 - b. Multi-component, rigid, high-solids, high modulus epoxy resin security sealant, ASTM C881, Type I and III, Grade 3, Classes B & C.
 - i. DynaPoxy EP-1200 by Pecora
 - ii. Sikadur -31 BY Sika USA
- 9. Roof Penetrations: Use asphalt mastic conforming to ASTM D491.
- 10. For other services, provide products especially formulated for the proposed use and accepted in advance by the Architect.

B. Colors:

- 1. The Architect will select Colors for each sealant installation to match adjacent finishes

from a standard color list normally available from the specified manufacturers.

2. Should a matching standard color not be available from the accepted manufacturer except at additional charge, the Contractor shall provide such colors at no additional cost to the Owner.
3. In concealed installations, and in partially or fully exposed installations where so accepted by the Architect, use standard gray or black sealant.

2.02 PRIMERS

Use only those primers that are: non-staining, have been tested for durability on the surfaces to be sealed, and are specifically recommended for this installation by the manufacturer of the sealant used.

2.03 BACKUP MATERIALS

- A. Use only those backup materials that are specifically recommended for this installation by the manufacturer of the sealant used, which are non-absorbent, and which are non-staining.
- B. Acceptable types include:
 1. Closed-cell resilient urethane or polyvinyl chloride foam;
 2. Closed-cell polyethylene foam;
 3. Closed-cell sponge of vinyl or rubber;
 4. Polychloroprene tubes or beads;
 5. Polyisobutylene extrusions;
 6. Oil-less dry jute.
- C. Preformed support strips for ceramic tile control joint and expansion joint work: Use polyisobutylene or polychloroprene rubber.

2.04 BOND-PREVENTATIVE MATERIALS

Use only one of the following as best suited for the application, and as recommended by the manufacturer of the sealant used:

1. Polyethylene tape, pressure-sensitive adhesive, with the adhesive required only to hold tape to the construction materials as indicated;
2. Aluminum foil complying with MIL-A-148E;
3. Wax paper complying with Fed. Spec. UU-P-270.

2.05 JOINT PACKING

Shall be installed in all joints to receive sealant. Material shall be a resilient type such as closed cell PVC foam or as recommended by the manufacturer. Oakum or other types of absorptive materials shall not be used as packing material.

2.06 OTHER MATERIALS

- A. For masking around joints, provide masking tape complying with Fed. Spec. UU-T-106c.
- B. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the acceptance of the Architect.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which work of this Section will be performed.

- B. Verify that specified items may be installed in accordance with the approved design.
- C. Correct conditions detrimental to timely and proper completion of the Work.
- D. Do not proceed until unsatisfactory conditions are corrected.
- E. Beginning of installation means acceptance of conditions.

3.02 PREPARATION

A. Concrete and ceramic tile surfaces:

- 1. Install only on surfaces that are dry, sound, and well brushed, wiping free from dust.
- 2. At open joints, remove dust by mechanically blown compressed air if so required.
- 3. Use solvent to remove oil and grease, wiping the surfaces with clean rags.
- 4. Where surfaces have been treated, remove the surface treatment by sandblasting or wire brushing.
- 5. Remove laitance and mortar from joint cavities.
- 6. Where backstop is required, insert the approved backup material into the joint cavity to the depth needed.

B. Steel surfaces:

- 1. Steel surfaces in contact with sealant:
 - a. Sandblast as required to achieve acceptable surface for bonding.
 - b. If sandblasting is not practical, or would damage adjacent finish, scrape the metal or wire brush to remove mill scale.
 - c. Use solvent to remove oil and grease, wiping the surfaces with clean rags.
- 2. Remove protective coatings on steel by sandblasting or by using a solvent that leaves no residue.

C. Aluminum surfaces:

- 1. Remove temporary protective coatings, dirt, oil, and grease.
- 2. When masking tape is used for protective cover, remove the tape just prior to applying the sealant.
- 3. Use only such solvents to remove protective coatings as are recommended for that purpose by the manufacturer of the aluminum work, and which are non-staining.

3.03 INSTALLATION OF BACKUP MATERIAL

- A. Use only the backup material recommended by the manufacturer of the sealant used, and accepted by the Architect for the particular installation, compressing the backup material 25% to 50% to achieve a positive and secure fit.
- B. When using backup of tub or rod stock, avoid lengthwise stretching of the material. Do not twist or braid hose or rod backup stock.
- C. Interior and exterior joints where no backing has been provided or which is in excess of 3/4" deep shall be packed by this subcontractor with fiberglass or a suitable joint filler to reduce the depth to 1/2" maximum. Maximum movement: the width of the joint shall be at least four times its maximum movement.

3.04 PRIMING

- A. Use only the primer recommended by the manufacturer of the sealant, and accepted by the Architect for the particular installation, applying in strict accordance with the manufacturer's recommendations as accepted by the Architect.

- B. The priming of joints shall be by brush to reach all surfaces to which compound will be applied. Primer shall be provided on masonry, concrete and wood surfaces as recommended by sealant manufacturer. Primer shall not be applied to surfaces that will be exposed after caulking is completed.

3.05 BOND-BREAKER INSTALLATION

Provide an approved bond-breaker where recommended by the manufacturer of the sealant, and where directed by the Architect, adhering strictly to the installation recommendations as accepted by the Architect.

3.06 INSTALLATION OF SEALANTS

- A. Prior to start of installation in each joint, verify the joint type according to details on the Drawings, or as otherwise directed by the Architect, and verify that the required proportion of width of joint to depth of joint has been secured.
- B. Equipment:
 - 1. Apply sealant under pressure with power-actuated or hand gun, or by other appropriate means.
 - 2. Use guns with nozzle of proper size, and providing sufficient pressure to completely fill the joints as designed.
- C. Thoroughly and complete mask joints where the appearance of sealant on adjacent surfaces would be objectionable.
- D. Install the sealant in strict accordance with the manufacturer's recommendations as accepted by the Architect, thoroughly filling joints to the recommended depth.
- E. Tool joints to the profile shown on the Drawings, or as otherwise required if such profiles are not shown on the Drawings.
- F. Cleaning up:
 - 1. Remove masking tape immediately after joints have been tooled.
 - 2. Clean adjacent surfaces free from sealant as the installation progresses, using solvent or cleaning agent recommended by the manufacturer of the sealant used.
 - 3. The excess material shall be cleaned from the surfaces adjacent to the joint, following the caulking operation and the top of the compound deposit shall be left with a smooth even finish. No material is permitted on the exposed face of aluminum sections.

END OF SECTION

SECTION 07 95 00

EXPANSION CONTROL

PART 1 — GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Requirements apply to this Section.

1.02 SUMMARY

A. This section includes the following:

1. Expansion and seismic joint systems for building interiors

1.03 DEFINITIONS

- A. Nominal Joint Width: The width of the expansion joint opening as specified in the project documents, at which the expansion joint will be constructed and the cover will be installed
- B. Maximum Joint Width: The widest expansion joint width which the joint cover is required to accommodate without damage to its components
- C. Minimum Joint Width: The narrowest expansion joint width which the joint cover is required to accommodate without damage to its components
- D. Movement Capability: The amount of movement in a single direction (open or close), given as a percentage of the nominal joint width, that the joint cover is required to accommodate without damage to its components
- E. Lateral Shear: Movement horizontally and parallel to the expansion joint
- F. Vertical Shear: Movement vertically and parallel to the expansion joint

1.04 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures

1.05 SUBMITTALS

- A. Submission must be made within fifteen (15) working days of the contract award to avoid project delay.
- B. Submittals shall contain the following as required for each specified system
 1. Shop Drawings showing complete fabrication details for all joint covers, including required anchorage to surrounding construction, recesses, blocking, backing, and connections between similar and dissimilar joint cover assemblies
 2. Manufacturer's product data including product details, installation instructions, maintenance and cleaning instructions, and Safety Data Sheets.
 3. Certificates, copies of independent test reports, or research reports showing compliance with fire resistance rating and other specified performance requirements
 4. Two (2) complete sets of color chips representing manufacturer's full range of available colors and patterns
 5. Three (3) 6" (152mm) samples of the specified systems

1.06 QUALITY ASSURANCE

- A. Manufacturer: Obtain joint cover assemblies through one source from a single manufacturer.
 1. Manufacturer shall have a third party certified ISO 9001 quality management system.

- a. The manufacturer shall have documented management and control of the processes that influence the quality of its products
 - b. The manufacturer shall have documented management and control of the processes that influence the quality of its customer service.
- 2. Manufacturer shall have a minimum of ten (10) years of experience in the fabrication of joint cover assemblies.
- B. Installer: All products listed in this section shall be installed by a single installer with demonstrated experience in installing products of the same type and scope as specified. Installer shall be insured and licensed as required by agencies within the project's jurisdiction.

1.07 COORDINATION

- A. Submittals shall be completed and approved prior to fabrication and shipment of material to the jobsite.
- B. Schedule for the work of this section shall be planned to allow sufficient time for manufacturer's production and delivery scheduling.
- C. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful and proper installation.
- D. Coordinate installation of exterior joint assemblies to ensure that transitions are watertight.
- E. Verify product types, quantities, dimensions, and attachment methods shown on shop drawings against field conditions prior to releasing materials for fabrication by the manufacturer.
- F. Communicate necessary changes on the manufacturer's shop drawings

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary protective cover on anodized aluminum, stainless steel, and bronze finished surfaces.
- B. Deliver joint covers to jobsite in clean, unopened crates of sufficient size and strength to protect materials during transit.
- C. Store components in original containers in a clean, dry location.

1.09 WARRANTY

- A. Submit manufacturer's warranty that materials furnished will perform as specified for a period of not less than five (5) years when installed in accordance with manufacturer's recommendations.

PART 2 — PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturer: Furnish and install as noted in specifications and as indicated on drawings as manufactured by Balco, Inc., PO Box 17249, 2626 S. Sheridan, Wichita, KS 67217; phone: 800-767-0082 or (316) 945-0789.

2.02 EXPANSION AND SEISMIC JOINT SYSTEMS

- A. Interior Expansion and Seismic Joint Systems
 - 1. WD-4 Snap-on Wall or Ceiling
 - 2. WDC-4 Snap-on Wall or Ceiling
 - 3. WDC-4 Acoustic Snap-on Ceiling System

2.03 MATERIALS

- A. Metals

1. Aluminum extrusions: ASTM B221, alloys 6063-T5, 6005A-T6, 6061-T6
 2. Aluminum plate and sheet: ASTM B209, alloys 6061-T6, 5052-H32
- B. Standard fasteners required for assembly and installation shall be included
- C. All surfaces in contact with masonry or concrete shall be protected by a factory-applied coating.

2.04 FINISHES

- A. Aluminum
1. Interior Walls and Ceilings:
 - a. Factory prime painted for finish paint in field
 2. All surfaces in contact with masonry or concrete shall be protected by a factory-applied coating

PART 3 — Execution

3.01 EXAMINATION

- A. Installer shall examine conditions under which work is to be performed and shall notify the contractor in writing of unsatisfactory conditions. Installer shall not proceed until all unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.02 PREPARATION

- A. Prepare surfaces using methods recommended by the manufacturer for achieving the required results within project conditions.
- B. Corner blockouts should be square, level, free of spalling or laitance, and meet the dimensions shown on shop drawings. Repairs should be made using appropriate materials as recommended by concrete repair material manufacturer, based on project-specific conditions.
- C. Concrete repair material must be applied and allowed to cure in accordance to the manufacturer of the product recommendations and instructions.
- D. Clean dirt, debris, and other contaminants from both the blockout and joint opening
- E. Mask areas adjacent to the joint as required to achieve neat, clean joint lines. Remove masking prior to the curing process.

3.03 INSTALLATION

- A. Install expansion and seismic joint covers in accordance with the manufacturer's instructions.
- B. Locate fasteners at interval recommended by manufacturer as shown on shop drawings.

3.04 PROTECTION AND CLEANING

- A. Protect the installation from damage by work of other sections.
- B. Where required, remove and store cover plates and install temporary protection over joints and re-install cover plates prior to substantial completion of work.
- C. Do not remove protective coverings until finish work in adjacent areas is complete.
- D. Prior to project closeout, clean exposed surfaces with a suitable cleaner as recommended by manufacturer.

END OF SECTION

SECTION 08 11 00

METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Standard and custom hollow metal doors and frames.
 - 2. Steel sidelight, borrowed lite and transom frames.
 - 3. Louvers installed in hollow metal doors.
 - 4. Light frames and glazing installed in hollow metal doors.
- B. Related Sections:
 - 1. Division 01 Section "General Conditions".
 - 2. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
 - 3. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
 - 4. Division 08 Section "Door Hardware".
 - 5. Division 08 Section "Access Control Hardware".
 - 6. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.
- C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
 - 2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
 - 3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
 - 4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
 - 5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
 - 6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.

10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.03 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".
- C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40" above sill) or UL 10C.
 1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
 2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
 3. Smoke Control Door Assemblies: Comply with NFPA 105.
 - i. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
- D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.
- E. Storm Shelter Openings: Provide complete door systems for hurricane or tornado storm shelters, and other areas of refuge, complying and tested according to ICC 500 (2014/2020), ICC/NSSA Standard for the Design and Construction of Storm Shelters.
 1. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- F. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.05 PROJECT CONDITIONS

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

1.06 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
- B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

1.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:
 - 1. CECO Door Products (C).
 - 2. Curries Company (CU).

1.02 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 38 percent.
- D. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

1.03 HOLLOW METAL DOORS

- A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.
- B. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Design: Flush panel.
 - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, or one-piece polystyrene core, securely bonded to both faces.
 - i. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 - 3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
 - 4. Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
 - 5. Vertical Edges: Vertical edges to have the face sheets spot welded and filled full height with an epoxy filler. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
 - 6. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
 - 7. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
 - 8. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- C. Manufacturers Basis of Design:
 - 1. Curries Company (CU) - Polystyrene Core - 707 Series.

1.04 HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.
 - 1. Frames: Minimum 18 gauge (0.042-inch -1.0-mm) thick steel sheet.
 - 2. Manufacturers Basis of Design:
 - i. Curries Company (CU) - C Series.
- C. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

1.05 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated

or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.

2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
 3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.
- C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

1.06 LIGHT OPENINGS AND GLAZING

- A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.
- B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.
- C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.
- D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

1.07 ACCESSORIES

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

1.08 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.
- C. Hollow Metal Doors:
 1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
 2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
 3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
 4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
- D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - i. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:
 - i. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches on-center and as follows:
 - a. Two anchors per jamb up to 60 inches high.
 - b. Three anchors per jamb from 60 to 90 inches high.
 - c. Four anchors per jamb from 90 to 120 inches high.
 - d. Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - ii. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - a. Three anchors per jamb up to 60 inches high
 - b. Four anchors per jamb from 60 to 90 inches high.
 - c. Five anchors per jamb from 90 to 96 inches high.
 - d. Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - e. Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with

UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

- E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

1.09 STEEL FINISHES

- A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

1.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

1.02 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.
- E. Verify tolerances against manufacturers installations instructions for tornado and hurricane storm shelter openings.

1.03 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.
 - 1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
 - 4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - i. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - ii. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - iii. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - iv. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

1.04 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

1.05 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
 - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

END OF SECTION

SECTION 08 11 23

INTERIOR ALUMINUM DOORS AND FRAMES

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Requirements apply to this Section.

1.02 SCOPE OF WORK SUMMARY

A. Section includes:

1. Aluminum-Framed Storefront

- a. Arcadia, Inc., AR450 Series, 2" x 4½" Non-Thermal; center glazed, screw spline, shear block, compensating stick or punched opening fabrication for ¼" glass.
- b. Arcadia, Inc., AR450 + Series, 2" x 4½" Non-Thermal; center glazed, screw spline, shear block, compensating stick or punched opening fabrication for 3/8" - 9/16" glass.
- c. Aluminum Doors and Frames

1.03 STANDARDS AND REFERENCES

- A. American Architectural Manufacturers Association (AAMA)
- B. American Society for Testing and Materials (ASTM)
- C. Aluminum Association (AA)

1.04 SYSTEM DESCRIPTION

A. General: In addition to requirements shown or specified, comply with:

1. Applicable provisions of AAMA Aluminum Storefront and Entrance Manual for design, materials, fabrication and installation of component parts.

B. Design Requirements: Arcadia AR450 & Ar450+ Series are framing systems suitable for outside or inside glazing.

C. Performance Requirements:

1. Limit air leakage through assembly to 0.06 CFM/min/sq. ft. (.00003 m³/sm²) of wall area at 6.24 PSF (300 Pa) as measured in accordance with ASTM E283.
2. Water Resistance: No water leakage when measured in accordance with ASTM E331 with a static test pressure of 10 PSF(480 Pa).
3. Dynamic Water Resistance: No water leakage, when measured in accordance with AAMA 501.1-94 with a dynamic test pressure of 10 PSF (480 Pa).
4. Limit mullion windload deflection of L/175 with full recovery of glazing materials, when measured in accordance with ASTM E 330.
5. System shall not deflect more than 1/8" at the center point, or 1/16" at the center point of a horizontal member, once deadload points have been established.
6. System shall accommodate expansion and contraction movement due to surface temperature differential of 180 degrees F.
7. Seismic testing shall conform to AAMA recommended static test method for evaluating performance of curtain walls and storefront wall systems due to horizontal displacements associated with seismic movements and building sway.

1.05 QUALITY ASSURANCE

- A. Single Source Responsibility:
 - 1. Obtain entrances, storefronts, ribbon walls, window walls, curtain walls, window systems, and finish through one source from a single manufacturer.
- B. Provide test reports from AAMA accredited laboratories certifying the performances as specified in 1.03.

1.06 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.07 SUBMITTALS

Provide in accordance with Section 01 33 00 Submittal Procedures.

1.08 WARRANTY

- A. System shall be warranted against failure and/or deterioration of metals due to manufacturing process for a period of two (2) years.

PART 2 – PRODUCTS

2.01 MANUFACTURERS:

- A. Basis of Design Manufacturer:
 - 1. Arcadia, Inc., 2301 E Vernon, Vernon, CA.
Telephone 323/269-7300, Fax 323/269-7390.
 - 2. Or Architect approved equal.
- B. Basis of Design Products:
 - 1. Arcadia, Inc., AR450 Series.
 - 2. Arcadia, Inc., AR450+ Series
 - 3. Arcadia, Inc., WS512 Wide Stile Doors 1-3/4”
 - a. Vertical Stiles: 5 inches.
 - b. Top Rail: 5-1/8 inches.
 - c. Bottom Rail: 10/12 inches.
 - d. Glazing Stops: (Square or Beveled) snap-in type for 1/4 to 1 inch infill.
 - 4. Major portions of the door stiles a nominal .125 inches and glass stops .050 inches thick.

2.02 FRAMING MATERIALS AND ACCESSORIES

- A. Framing members, transition members, mullions, adaptors, and mounting: Extruded 6063-T6 aluminum alloy (ASTM B221 – Alloy G.S. 10a T6). Screws, fastening devices, and internal components: Aluminum, stainless steel, or zinc-plated steel in accordance with ASTM.A-164. Perimeter anchors shall be aluminum or steel, providing the steel is properly isolated from aluminum.
- B. Glazing Gasket
 - 1. Compression-type design, replaceable, molded or extruded santoprene, polyvinyl chloride (PVC), or ethylene propylene diene monomer (EPDM).
 - 2. Shall be of type that locks securely into the glazing reglet to prevent glazing gaskets from disengaging.

2.03 FINISH

- A. Finish all exposed areas of aluminum and components as indicated.
 - 1. An Architectural Class II or I anodic coating conforming with AA-M12C22A31/AA-M12C22A41.
 - a. Anodize finish color shall be Colornodic #11 Clear

2.04 SYSTEM FABRICATION

- A. Continuous sub-sill shall be provided under sill members to collect water infiltration and divert from the interior of the system.
- A. Framing members shall be internally reinforced and secured at head and sill as necessary for structural performance requirements, for hardware attachment, and as indicated.
- B. Fasteners shall be so located as to ensure concealment from view in the final assembly.

2.05 DOOR FABRICATION

- A. Stiles and rails shall be tubular sections accurately joined, flush and hairline at corners with heavy concealed reinforcement brackets secured with machine bolts, with optional MIG weld. Exposed screws not permitted.
- B. Each door leaf equipped with an adjusting mechanism, located in the top rail near the lock stile.
- C. Prepare internal reinforcement for door hardware.
- D. Custom hardware templates and physical hardware must be submitted prior to any fabrication.

PART 3 – EXECUTION

3.01 EXAMINATIONS

- A. Examine conditions and verify substrate conditions are acceptable for product installation.

3.02 INSTALLATION

- A. Install in accordance with approved shop drawings and manufacturers installation instructions.

3.03 FIELD QUALITY CONTROL

- A. Test the storefront for water leaks in accordance with AAMA 501.2. Conduct test in the presence of the Architect. Correct deficiencies observed as a result of this test.

END OF SECTION

SECTION 08 14 00

WOOD DOORS

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 SCOPE OF WORK SUMMARY

A. Section Includes:

1. Interior flush wood doors.

B. Related Requirements:

1. Section 08 71 00: Door hardware.

1.03 STANDARDS AND REFERENCES

Comply with the Industry Standards and References as established by Manufacturer.

1.04 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Pre-installation Meeting

1. Conduct pre-installation meeting at Project Site.
2. Discuss Topics:
 - a. Delivery, storage and handling
 - b. Coordination and Hardware and access control installers.
 - c. Protection of installed doors.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

A. Provide in accordance with Section 01 33 00 Submittal Procedures.

B. Product Data: Each type of door and finish.

1. Core and edge construction.
2. Fire rated doors.
3. Finishes.

C. Shop Drawings and Schedule:

1. Use same unit designations used in Contract Documents.
2. Hardware and wiring chase preparation.

D. Samples for Verification:

1. Each required plastic laminate; corner unit showing construction and finish minimum 8 by 10 inches.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Comply with the requirements of Section 01 66 00 Product Storage and Handling Requirements.
- B. Package factory-finished doors individually in manufacturer's standard plastic bags, stretch wrap, or cardboard cartons.
- C. Store doors inside building in clean, dry location.
- D. Mark each door on top bottom rail with opening number used on Shop Drawings.

1.08 PROJECT CONDITIONS

- A. Comply with the requirements of Section 01 50 00 Construction Facilities.
- B. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity at occupancy levels during remainder of construction period.

1.09 OPERATION AND MAINTENANCE DATA

- A. Provide in accordance with Section 01 77 00 Project Closeout.
- B. Maintenance data.
- C. Manufacturer warranties transferrable to Owner.

1.10 WARRANTIES

- A. Provide manufacturer's Standard Warranty in accordance with Section 01 78 36 Warranties.
- B. Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch (6 mm) in 42-by-84-inch (1065-by-2130-mm) section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in 3-inch (0.25 mm in 76-mm) span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
- C. Warranty Periods:
 - 1. Solid-Core Interior Doors: Life of installation.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Products of Aspiro™ Series | Marshfield-Algoma by Forte Opening Solutions are specified to indicate requirements for quality and appearance.
 - 1. Website: forteopenings.com
 - 2. Phone: 877.332.4484
- B. Approved alternates
 - 1. Oregon Door
 - 2. Lynden Door – LD Series Only

3. Architect approved equal.

C. Source Control: Supply all wood doors from a single manufacturer.

2.02 MANUFACTURING STANDARDS

- A. Interior Flush Wood Doors: Window & Door Manufacturers Association publication ANSI/WDMA I.S. 1A "Industry Standard for Interior Architectural Wood Flush Doors".
- B. Fire-Rated Wood Doors: Conforming to NFPA 80; listed and labeled for required ratings based on testing at positive pressure NFPA 252 or UL 10C by UL or other testing agency acceptable to authorities having jurisdiction
 1. Temperature-Rise Limit: Where indicated, provide doors that have a maximum transmitted temperature end point of not more than 250 deg F (121 deg C) above ambient after 30 minutes of standard fire-test exposure.
 2. Blocking: Provide composite blocking approved for use in doors of fire-protection ratings indicated as needed to maintain WDMA performance level and eliminate through-bolting hardware.
 3. Vertical Edge Construction:
 - a. Category A Positive Pressure: Integral intumescent seals concealed by outer stile where required.
 4. Pairs: Fire-retardant stiles with concealed intumescent seals that are listed and labeled for applications indicated without formed-steel edges and astragals.
- C. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control

2.03 SOLID CORE FLUSH WOOD DOORS FOR TRANSPARENT FINISH – SELECT WOOD VENEER

- A. Basis of Design: Aspiro™ Series | Marshfield-Algoma™ by Forte Opening Solutions.
- B. Solid Core Select Wood Veneer Flush Doors:
 1. WDMA Quality grade: Custom
 2. WDMA Performance Level: Extra Heavy Duty
 3. Faces
 - a. Veneer Grade: AA
 - b. Veneer Species: As indicated in Drawings.
 - c. Veneer Species: As indicated in Drawings.
 - d. Veneer Leaf Match: Book match.
 - e. Veneer Face Match/Assembly: Running
 4. Vertical Edges: Structural composite lumber matching 1/8" (3.2mm) high impact edge bonded to structural composite lumber.
 5. Horizontal Edges: Structural composite lumber
 6. Core: Wood-based Particleboard (PC).
 7. Construction: Five Plies; stiles and rails bonded to core, and entire unit is abrasive planed before veneering.
 8. Thickness: 1-3/4 inch
- C. Solid Core Select Wood Veneer Flush Doors with Glazed Lites

1. Match appearance grade and applicable construction and performance requirements of other standard veneer flush solid core wood doors.
2. Factory Glazing: Refer to Section 08 80 00 Glazing for glass view panels in flush wood doors. Factory install glass as required. Fill glazing bead nail holes in factory finished doors.
3. Metal Glazing Frames: Manufacturer's standard frame formed of 0.048-inch- (1.2-mm-) thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish.
4. Frame Design: Metal Vision Frame 110

2.04 SOLID CORE LAMINATE-FACED (HPDL) DOORS – CHOICE LAMINATE

A. Basis of Design: Aspiro™ Series | Marshfield-Algoma™ by Forte Openings Solutions.

B. Solid Core Choice Laminate (HPDL) Flush Doors:

9. WDMA Quality grade: Custom
10. WDMA Performance Level: Extra Heavy Duty
11. Faces: High-pressure decorative laminates complying with NEMA LD 3, Grade HGS. Vertical and post formable grade laminates are not acceptable.
 - a. Colors, Patterns: As indicated in the Drawings
 - b. Acceptable manufacturer: Wilsonart Standard Laminate
12. Vertical Edges: Matching HPDL Edge Band applied after faces over Structural Composite Lumber. Matching 1/8 inch (3.2mm) high impact edge bonded to structural composite lumber.
13. Horizontal Edges: Structural composite lumber.
14. Core: Wood-based Particleboard (PC).
15. Construction: Five Plies; stiles and rails bonded to core, and entire unit is abrasive planed. High pressure decorative laminate with high density fiberboard (HDF) crossbands.
16. Thickness: 1-3/4 inch

C. Solid Core Choice Laminate (HPDL) Flush Doors with Glazed Lites:

1. Match appearance grade and applicable construction and performance requirements of other laminate finish flush wood doors.
2. Factory Glazing: Refer to Section 08 80 00 "Glazing" for glass view panels in flush wood doors. Factory install glass as required. Fill glazing bead nail holes in factory finished doors.
3. Metal Glazing Frames: Manufacturer's standard frame formed of 0.048-inch- (1.2-mm-) thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish.
 - a. Frame Design: Metal Vision Frame 110

D. Fire-Rated Choice Laminate (HPDL) Flush Doors:

1. Match appearance grade and applicable construction and performance requirements of other laminate finish flush wood doors.
2. Ratings: Category A positive pressure
 - a. 20-Minute Doors: Wood-based particleboard core
 - b. 45-, 60-, 90-Minute Doors: Mineral core with blocking options.

3. Vertical Edges: High pressure decorative laminate over hardwood composite fire stile.

E. Fire-Rated Choice Laminate (HPDL) Flush Doors with Glazed Lites:

1. Match appearance grade and applicable construction and performance requirements of non-rated transparent finish flush wood doors.
2. Factory Glazing: Refer to Section 08 00 00 Glazing for glass view panels in flush wood doors. Factory install glass as required. Fill glazing bead nail holes in factory finished doors.
3. Glazing: Factory- installed fire-rated safety glass for door rating.
4. Factory Glazing: Refer to Section 08 80 00 "Glazing" for glass view panels in flush wood doors. Factory install glass as required. Fill glazing bead nail holes in factory finished doors.
5. Metal Glazing Frames: Manufacturer's standard frame formed of 0.048-inch- (1.2-mm-) thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish.
6. Frame Design: Metal Vision Frame 110

2.05 DOOR CORE MATERIALS

- A. Particleboard: Wood-based particleboard; ANSI A208.4, Grade LD-2 as required to meet WDMA Performance Duty level specified without added blocking.
- B. Structural Composite Lumber: WDMA T.M.10.

2.06 FABRICATION

- A. Factory Fitting: Fit to frame openings with clearances specified in WDMA I.S. 1A.
 1. Undercut: Maximum 3/8 inch (10 mm) above thresholds.
 2. Fire-Rated Doors: Comply with NFPA 80.
- B. Factory Machining: Machine doors for hardware that is not surface applied.
 1. Verify dimensions for hardware mortises in metal frames before machining.
- C. Door Frames:
 1. Supply frames with temporary spreader bars at base.

2.07 FINISHES

- A. Finish Grade: Match grade of door.
- B. Transparent: WDMA TR-8, UV-Cured Acrylated Polyester/Urethane.
 1. Staining: As indicated in Drawings.
 2. Sheen: Satin.
- C. Choice Laminate (HPDL)

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that door frames are plumb, square, and accurate size.
- B. Inspect each door before installation for damage and defects per WDMA Section F-6.

3.02 INSTALLATION

- A. Hardware installation is conforming to Section 08 7100 – Door Hardware.

B. Reference Standards:

1. Wood Doors: WDMA I.S. 1A
2. Fire-Rated Doors: NFPA 80.
3. Smoke-and Draft-Control Doors: NFPA 105.

C. Align doors with uniform vertical and top edge clearance.

3.03 REPAIR

- A. Repair of damage or defects is subject to Architect's acceptance, including removal of soiling.
Provide new replacement doors for doors that cannot be satisfactorily repaired.

3.04 PROTECTING AND CLEANING

- A. Protect installed doors from damage and soiling.
- B. Clean doors shortly before inspection for Substantial Completion.

END OF SECTION

SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 SCOPE OF WORK SUMMARY

- A. Non-Rated Architectural wall and ceiling access door.
- B. Related hardware and attachments.
- C. Design Requirements: Verification: Obtain specific locations and sizes for required access doors and frames from trades, including mechanical and electrical, requiring access to concealed equipment and indicate on submittal schedule.

1.03 STANDARDS AND REFERENCES

Comply with the Industry Standards and References as established by Manufacturer.

1.04 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.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

- A. Provide in accordance with Section 01 33 00 Submittal Procedures.
- B. Shop Drawings:
 - 1. Door and panel units: Show types, elevations, thickness of metals, full size profiles of door members.
 - 2. Hardware: Show materials, finishes, locations of fasteners, types of fasteners, locations and types of operating hardware, and details of installation.
 - 3. General: Show connections of units and hardware to other Work. Include schedules showing location of each type and size of door and panel units.
- C. Product Data: Manufacturer's technical data for each type of access door and panel assembly, including setting drawings, templates, fire-resistive characteristics, finish requirements, and details of anchorage devices. Include complete schedule, types, locations, construction details, finishes, latching or locking provisions, and other pertinent data.
- D. Manufacturer's Installation Instructions: Indicate installation requirements and rough-in dimensions.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Comply with Section 01 66 00 Product Storage and Handling Requirements.
- B. Package and ship per manufacturer's recommendations.
- C. Store per manufacturer's instructions.

D. Store in dry area out of direct sunlight.

1.08 PROJECT CONDITIONS

Comply with the requirements of Section 01 50 00 Construction Facilities.

1.09 OPERATION AND MAINTENANCE DATA

Provide in accordance with Section 01 77 00 Project Closeout.

1.10 WARRANTY

Provide Manufacturer's Standard Warranty in accordance with Section 01 78 36 Warranties.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Nystrom Building Products: 9300 73rd Avenue North Brooklyn Park, MN 55428. Telephone: 800-547-2635. E-Mail: info@nystrom.com. Website: www.nystrom.com

B. Specifications and Drawings are based on manufacturer's literature from Nystrom Building Products. Other manufacturers shall comply with minimum levels of material, color selection, and detailing indicated in Specifications or on Drawings.

2.02 MATERIALS

A. Commercial quality, cold steel sheet with white baked on powder coat finish.

B. Galvanized, bonderized steel with white baked on powder coat finish.

2.03 ACCESS PANELS

A. Flush Access Doors (Model: NT Architectural) with Exposed Flanges for drywall (Non-Rated, General Purpose Access Door)

1. Door: Fabricate from 16-gauge cold rolled sheet steel, with multiple mounting configurations.

2. Door Size: 18"x18" (see Plans for locations)

3. Frame: Nominal 0.063 inch, 16 gauge with 1" exposed flange

4. Hinge:

a. Concealed spring button type, to allow for door removal.

5. Latching/Locking Devices: Cam latch, hex-head wrench operated

6. Finish:

a. Type: No. 304 stainless steel with No. 4 satin polish finish.

2.04 FABRICATION

A. Manufacture each access panel assembly as an integral unit ready for installation.

B. Framing to include integral anti-flexing technology, with ¼ inch mounting holes, to reduce the twist of frame during installation.

C. Easy Install Tabs integral to framing for multiple installation methods.

D. Furnish number of latches required to hold door in flush, smooth plane when closed.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine the areas and conditions under which work of this Section will be performed.

- B. Verify that rough openings for door and frame are correctly sized and located.
- C. Verify mechanical and electrical requirements for ceiling or wall access panels.
- D. Correct conditions detrimental to timely and proper completion of the Work.
- E. Do not proceed until unsatisfactory conditions are corrected.
- F. Beginning of installation means acceptance of conditions.

3.02 PREPARATION

Advise installers of work relating to access panel installation including rough opening dimensions, locations of supports, and anchoring methods. Coordinate delivery with other work to avoid delay.

3.03 INSTALLATION

- A. Install access door and frame units per manufacturer's written instructions.
- B. Install frames plumb and level in opening. Secure rigidly in place.
- C. Position units to provide convenient access to concealed Work requiring access.

3.04 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 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Requirements apply to this Section.

1.02 SCOPE OF WORK SUMMARY

A. Section includes:

1. Aluminum-Framed Storefront

- a. Arcadia, Inc., AG451T Series, 2" x 4-1/2" Thermally broken; center glazed system, screw spline, shear block, compensating stick or punched opening fabrication for 1" glass.

2. Flush Panel Doors

1.03 STANDARDS AND REFERENCE

A. American Architectural Manufacturers Association (AAMA)

B. American Society for Testing and Materials (ASTM)

C. Aluminum Association (AA)

1.04 SYSTEM DESCRIPTION

A. General: In addition to requirements shown or specified, comply with:

- 1. Applicable provisions of AAMA Aluminum Storefront and Entrance Manual for design, materials, fabrication and installation of component parts.

B. Design Requirements: Arcadia AG451T Series is a framing system that provides for flush glazing on all sides without projected stops, with glass in the center of the frame. Framing system suitable for outside or inside glazing.

C. Design Requirements: Arcadia RP325 Series Flush Panel Entrance System is a single source package of door, doorframe and hardware that is engineered for excessive traffic or difficult environmental conditions.

D. Performance Requirements:

- 1. Limit air leakage through assembly to 0.06 CFM/min/sq. ft. (.00003 m³/sm²) of wall area at 6.24 PSF (300 Pa) as measured in accordance with ASTM E283.
- 2. Water Resistance: No water leakage when measured in accordance with ASTM E331 with a static test pressure of 8 PSF(383 Pa).
- 3. Limit mullion windload deflection of L/175 with full recovery of glazing materials, when measured in accordance with ASTM E 330.
- 4. System shall not deflect more than 1/8" at the center point, or 1/16" at the center point of a horizontal member, once deadload points have been established.
- 5. System shall accommodate expansion and contraction movement due to surface temperature differential of 180 degrees F.
- 6. Seismic testing shall conform to AAMA recommended static test method for evaluating performance of curtain walls and storefront wall systems due to horizontal displacements associated with seismic movements and building sway.

7. Thermal Performance – When tested in accordance with AAMA 1503.1 the following results should be attained: U-Maximum .63/CRF – minimum of 59.
8. National Fenestration Rating Council (NFRC) specific application evaluation.

1.05 QUALITY ASSURANCE

- A. Single Source Responsibility:
 1. Obtain entrances, storefronts, ribbon walls, window walls, curtain walls, window systems, and finish through one source from a single manufacturer.
- B. Provide test reports from AAMA accredited laboratories certifying the performances as specified in 1.03.

1.06 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.07 SUBMITTALS

Provide in accordance with Section 01 33 00 Submittal Procedures.

1.08 WARRANTY

- A. System shall be warranted against failure and/or deterioration of metals due to manufacturing process for a period of two (2) years.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Manufacturer:
 1. Arcadia, Inc., 2301 E Vernon, Vernon, CA.
Telephone 323/269-7300, Fax 323/269-7390.
 2. Or Architect approved equal.
- B. Basis of Design Products:
 1. Arcadia, Inc., AG451T Series.
 2. Arcadia, Inc., RP325 Series Flush Panel Entrance, 1-3/4".
 - a. Door stiles, rails shall have a nominal .125" wall thickness.

2.02 FRAMING MATERIALS AND ACCESSORIES

- A. Framing members, transition members, mullions, adaptors, and mounting: Extruded 6063-T6 aluminum alloy (ASTM B221 – Alloy G.S. 10a T6).
- B. Screws, fastening devices, and internal components: Aluminum, stainless steel, or zinc-plated steel in accordance with ASTM.A-164. Perimeter anchors shall be aluminum or steel, providing the steel is properly isolated from aluminum.
- C. Glazing Gasket
 1. Compression-type design, replaceable, molded or extruded, or ethylene propylene diene monomer (EPDM).
 2. Shall be of type that locks securely into the glazing reglet to prevent glazing gaskets from disengaging.

2.03 HARDWARE

- A. Hardware furnished and installed by the door manufacturer, and include the following standard hardware (as selected).
1. Weatherstripping: Hard-backed poly pile in door and/or frame. Meeting stile of all pair of doors have a double line hard-backed poly-pile astragal.
 2. Threshold: Extruded Aluminum with ribbed surface.
 3. Sill Sweeps: Nylon brush strip (exposed, concealed).
 4. Pivoting/Hinging: (Center, offset pivot; butt, continuous.)
 5. Closers: (Overhead concealed, surface, floor.)
 6. Latches/Strike: (Dead-latch combination, two-point.)
 7. Latch Handle: (Lever, eurostyle/ w/return, paddle.)
 8. Electric Release: (Offset strike, center hung strike.)
 9. Locks/Strike: (Maximum security hooklock, deadbolt.)
 10. Auxiliary Locks: (Active two-point, active/inactive three-point, active three-point, flushbolts.)
 11. Cylinders: (Mortise, rim, dummy, thumbturn.)
 12. Panic Devices: (Cross, touch bar, flush mid panel.)
 13. Push/Pulls: (Standard, offset radius, straight radius.)
 14. Cylinder Guard: (Security ring/retainer ring.)
 15. Exit Indicator: (Message panel.)
 16. Transom Decal: (This door to remain . . .)
 17. Door Stop/Holder:

SPECIFIER NOTE: Refer to Arcadia Architectural Manual, Hardware Section for description of items 4-17.

2.04 FINISH

- A. Finish all exposed areas of aluminum and components as indicated.
1. An Architectural Class II or I anodic coating conforming with AA-M12C22A31/AA-M12C22A41.
 - a. Anodize finish color shall be Colornodic #11 Clear

2.04 DOOR FABRICATION

- A. Door sections to receive and conceal cut edges of face sheets.
- B. Rails joined to tubular stiles by 3/8-inch steel rods.
- C. Face sheets lap and interlock stiles and rails.
- D. Prepare internal reinforcement for door hardware.
- E. Custom hardware templates and physical hardware must be submitted prior to any fabrication.

2.04 SYSTEM FABRICATION

- A. Continuous sub-sill shall be provided under sill members to collect water infiltration and divert from the interior of the system.
- B. Framing members shall be internally reinforced and secured at head and sill as necessary for structural performance requirements, for hardware attachment, and as indicated.

- C. Fasteners shall be so located as to ensure concealment from view in the final assembly.

PART 3 – EXECUTION

3.01 EXAMINATIONS

- A. Examine conditions and verify substrate conditions are acceptable for product installation.

3.02 INSTALLATION

- A. Install in accordance with approved shop drawings and manufacturers installation instructions.

3.03 FIELD QUALITY CONTROL

- A. Test the storefront for water leaks in accordance with AAMA 501.2. Conduct test in the presence of the Architect. Correct deficiencies observed as a result of this test.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Sliding doors.
 - 3. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
 - 3. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section "Hollow Metal Doors and Frames".
 - 2. Division 08 Section "Flush Wood Doors".
 - 3. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series.
 - 2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
 - 3. ANSI/UL 294 - Access Control System Units.
 - 4. UL 305 - Panic Hardware.
 - 5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 - 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 - 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
 - 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.
 - 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Proof of Compliance: (California located Projects): Provide a list of product(s) containing chemicals known to cause cancer or reproductive toxicity as defined by the Office of Environmental Health Hazard Assessment (OEHHA) under Proposition 65 (CA Code of Regulations, Title 27, Section 27001). The list includes the specific chemical(s), if the chemical will be exposed to consumers, the means of warning, and an illustration of the label.
- F. Informational Submittals:
 - 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

- A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.
- B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. California Building Code: Provide hardware that complies with CBC Section 11B.
 - 1. All openings as a part of an accessible route shall comply with CBC Section 11B-404.

2. The clear opening width for a door shall be 32" minimum. For a swinging door it shall be measured between the face of the door and the stop, with the door open 90 degrees. There shall be no projections into it below 34" and 4" maximum projections into it between 34" and 80" above the finish floor or ground. Door closers and stops shall be permitted to be 78" minimum above the finish floor or ground. CBC Section 11B-404.2.3.
3. Operable hardware on accessible doors shall comply with CBC Section 11B-309.4 and shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. Operable parts of such hardware shall be 34" minimum and 44" maximum above finish floor or ground. Where sliding doors are in the fully open position, operating hardware shall be exposed and usable from both sides.
4. Hardware (including panic hardware) shall not be provided with "nightlatch" function for any accessible doors or gates unless the following conditions are met:
 - a. Such hardware has a 'dogging' feature and is dogged during the time the facility is open.
 - b. All 'dogging' operation is performed only by employees as their job function (non-public use).
5. The force for pushing or pulling open a door shall be in accordance with CBC Section 11B-404.2.9.
 - a. Interior hinged doors, sliding or folding doors, and exterior hinged doors: 5 pounds (22.2 N) maximum. Required fire doors: the minimum opening force allowable by the DSA authority, not to exceed 15 pounds (66.7N). These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position.
 - b. The force required for activating any operable parts, such as lever hardware, or disengaging other devices shall be 5 pounds (22.2N) maximum to comply with CBC Section 11B-309.4.
 - c. The 5 pound (22.2 N) maximum force shall be validated for the size of the door used. The Building Materials Listing of the California State Fire Marshal shall indicate that the door hardware meets the 5 pound (22.2 N) force and shall also list the largest door that can be used.
6. Door closing speed shall comply with CBC Section 11B-404.2.8. Closers shall be adjusted so that the required time to move a door from an open position of 90 degrees to a position of 12 degrees from the latch is 5 seconds minimum. Spring hinges shall be adjusted so that the required time to move a door from an open position of 70 degrees to the closed position is 1.5 seconds minimum.
7. Floor stops shall not be located in the path of travel and 4" maximum from walls.
8. Thresholds shall comply with CBC Section 11B-404.2.5.
- G. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- H. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 1. Function of building, purpose of each area and degree of security required.
 2. Plans for existing and future key system expansion.
 3. Requirements for key control storage and software.

4. Installation of permanent keys, cylinder cores and software.
 5. Address and requirements for delivery of keys.
 - I. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
 - J. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.
- 1.6 DELIVERY, STORAGE AND HANDLING
- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
 - B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
 - C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".
- 1.7 COORDINATION
- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
 - B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.
- 1.8 WARRANTY
- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
 - B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship

within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
 2. Faulty operation of the hardware.
 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.
 5. Manufacturers:
 - a. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.2 CONTINUOUS HINGES

- A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:.

- a. Pemko (PE).

2.3 POWER TRANSFER DEVICES

- A. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

- a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
 - b. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

- a. McKinney (MK) - QC-C Series.

2.4 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
 4. Tubular deadlocks and other auxiliary locks.
 5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 6. Keyway: Match Facility Standard.

- C. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 3. Existing System: Field verify and key cylinders to match Owner's existing system.

- D. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
 2. Master Keys (per Master Key Level/Group): Five (5).
 3. Construction Keys (where required): Ten (10).

- E. Construction Keying: Provide construction master keyed cylinders.

- F. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.5 MORTISE LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:
 - a. Sargent Manufacturing (SA) - 8200 Series.

2.6 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

- B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.7 ELECTROMAGNETIC LOCKING DEVICES

- A. Surface Electromagnetic Locks (Commercial Duty): Electromagnetic locks to be surface mounted type conforming to ANSI A156.23, Grade 3 with minimum holding force strength of 600 pounds. Locks to autosense either 12 or 24 voltage and be UL listed for use on fire rated door assemblies. Locks are to have an integrated door position switch and lock bond sensor. Locks are to have optional integrated motion sensor and/or security camera as indicated in the hardware sets. Provide mounting accessories as needed to suit opening conditions. Power supply to be by the same manufacturer as the lock with combined products having a lifetime replacement warranty.

1. Manufacturers:
 - a. Securitron (SU) - M380E Series.

2.8 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as

required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.
 1. Manufacturers:
 - a. Sargent Manufacturing (SA) - 80 Series.

2.9 SURFACE DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
 4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Heavy duty surface mounted door closers shall have a 30-year warranty.
 2. Manufacturers:
 - a. Norton Rixson (NO) - 7500 Series.
- 2.10 DOOR STOPS AND HOLDERS
- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
1. Manufacturers:
 - a. Rockwood (RO).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
1. Manufacturers:
 - a. Norton Rixson (RF).
 - b. Rockwood (RO).
 - c. Sargent Manufacturing (SA).
- 2.11 ARCHITECTURAL SEALS
- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
 - 1. Pemko (PE).

2.12 ELECTRONIC ACCESSORIES

- A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
 - 1. Manufacturers:
 - a. Securitron (SU) - DPS Series.
- B. Intelligent Switching Power Supplies: Provide the least number of power supplies at the appropriate amperage level sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
 - 1. Power supplies shall meet all functions and features as specified herein.
 - a. UL listed dual voltage 12 or 24 VDC field selectable continuous output.
 - b. Dedicated fast charger to prolong battery life with low battery cutoff to protect batteries from deep discharge.
 - c. Enhanced surge immunity for input/output protection
 - d. Separate, dedicated battery charging circuit to keep locks cooler.
 - e. Dual-color LED visual notification to prevent applying incorrect voltages to the power supply.
 - f. Instant auto-switch to battery on AC loss.
 - g. Expandable up to 16 outputs in the standard enclosure
 - h. Integrated fire alarm interface to allow main output shutdown or disconnect on a per output basis when using an R8 output module.
 - i. Network ready and remotely manage locks and connected devices when using an M8 managed output module on network models.
 - j. Lifetime replacement, no-fault, no questions asked warranty.
 - 2. Manufacturers:
 - a. Securitron (SU) - AQL Series.

2.13 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.14 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage,

and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

- D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
 - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

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

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
 - 1. Quantities listed are for each pair of doors, or for each single door.
 - 2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

Hardware Sets

Set: 1.0

Doors: E1112A

Description: EXT SGL - MEDIA ROOM

1 Continuous Hinge	CFM HD1		PE
1 Rim Exit Device, Exit Only	5CH 43 8810 EO x 525	US32D	SA
1 Surface Closer - Closer Stop	CPS7500	689	NO
1 Drop Plate	as req'd	689	NO
1 Gasketing/Seals	by Alum. Door/Frame Mfg.		
1 Sweep	18062CNB		PE
1 Threshold	171A or Per Sill Detail		PE

Set: 2.0

Doors: 1112A

Description: INT PAIR - MEDIA ROOM

2 Continuous Hinge	CFM HD1		PE
1 Concealed Vert Rod Exit, Classroom	5CH 16 43 AD8613 ETP x 525	US32D	SA
1 Concealed Vert Rod Exit, Dummy	5CH 16 43 AD8610 ETP x 525	US32D	SA
1 Rim Cylinder	as req'd - Match existing key system		
2 Mortise Cylinder	as req'd - Match existing key system		
2 Conc Overhead Stop (Alum Storefront)	6-X36	630	RF
2 Surface Closer - Parallel Rigid Arm	PR7500	689	NO
2 Drop Plate	as req'd	689	NO
1 Gasketing/Seals	by Alum. Door/Frame Mfg.		
1 Threshold	271A or Per Sill Detail		PE

Set: 3.0

Doors: 1113

Description: INT SGL - OFFICE/PRODUCTION (CARD READER)

2 Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1 Hinge, Full Mortise	TA2714 QCW	US26D	MK

1	Fail Secure Lock	LC RX 8271 LNP	US26D	SA	↗
1	Mortise Cylinder	as req'd - Match existing key system			
1	Surface Closer - Tri-pack	7500 Mounting as Req'd	689	NO	
1	Wall Stop	406	US32D	RO	
1	Acoustic Seal Set (Seal sets, Door Bottom)	PEMKOSTCSET-1A	BL	PE	
1	ElectroLynx Frame Harness	QC-C1500P		MK	↗
1	ElectroLynx Door Harness	QC-C__P		MK	↗
1	Position Switch	DPS		SU	↗
1	Power Supply w/ Power Distribution Board	AQL Series-R8E1 as Req'd		SU	↗

Notes: Card Reader and wiring to electrified hardware by Security Contractor.

Operational description:

Door is normally closed and secured. Presenting a valid credential will momentarily unlock door, allowing access. Once the door closes, the door remains closed and locked. Free egress at all times. During a power outage, the door will remain closed and locked and will continue to allow free egress.

Set: 4.0

Doors: 1112B

Description: INT SGL - MEDIA ROOM (CARD READER/CARD READER, MAG LOCK)

2	Hinge, Full Mortise	TA2714 (NRP)	US26D	MK	
1	Hinge, Full Mortise	TA2714 QCW	US26D	MK	
1	Fail Secure Lock	LC RX 8271 LNP	US26D	SA	↗
1	Magnetic Lock	M380EBD	630	SU	↗
1	Mortise Cylinder	as req'd - Match existing key system			
1	Surface Closer - Tri-pack	7500 Mounting as Req'd	689	NO	
1	Wall Stop	406	US32D	RO	
1	Acoustic Seal Set (Seal sets, Door Bottom)	PEMKOSTCSET-1A	BL	PE	
1	ElectroLynx Frame Harness	QC-C1500P		MK	↗
1	ElectroLynx Door Harness	QC-C__P		MK	↗
1	Position Switch	DPS		SU	↗
2	Card Reader	by Security - Division 28			
1	Power Supply w/ Power Distribution Board	AQL Series-R8E1 as Req'd		SU	↗

Notes: Card Reader and wiring to electrified hardware by Security Contractor.

Operational description:

Door is normally closed and secure. Presenting a valid credential at either side of the door will momentarily unlock lever trim and releases the mag lock, allowing access. Once the door closes, the door remains closed and secure. During a power outage, the door will remain closed and locked and will allow

free egress.

Set: 5.0

Doors: 1114

Description: INT SGL - OFFICE/POST EDITING

4	Hinge, Full Mortise	TA2714 (NRP)	US26D	MK
1	Office/Entry Lock	LC 8205 LNP	US26D	SA
1	Mortise Cylinder	as req'd - Match existing key system		
1	Wall Stop	406	US32D	RO
1	Acoustic Seal Set (Seal sets, Door Bottom)	PEMKOSTCSET-1A	BL	PE

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 SCOPE OF WORK SUMMARY

Supply and install all Material and Labor, as shown on Drawings and as specified herein, including all accessories and hardware for a timely, complete, and proper installation:

- A. High-performance architectural glass.
- B. High-performance insulating glass.

1.03 STANDARDS AND REFERENCES

- A. ANSI Z97.1 – American National Standard for Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test
- B. CPSC 16 CFR 1201 – Safety Standard for Architectural Glazing Materials
- C. Glazing Publications: Comply with published recommendations of glass product manufacturers and industry organizations, including but not limited to those below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. IGMA Publication for Insulating Glass: IGMA TM-3000, Glazing Guidelines for Sealed Insulating Glass Units.
 - 2. GANA Publications: Laminated Glazing Reference Manual; Glazing Manual.
- D. ASTM International:
 - 1. ASTM C162 – Standard Terminology of Glass and Glass Products.
 - 2. ASTM C1036 – Standard Specification for Flat Glass.
 - 3. ASTM C1048 – Standard Specification for Heat-Treated Flat Glass – Kind HS, Kind FT Coated and Uncoated Glass.
 - 4. ASTM C1172 – Standard Specification for Laminated Architectural Flat Glass.
 - 5. ASTM C1376 – Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
 - 6. ASTM E2188 – Standard Test Method for Insulating Glass Unit Performance.
 - 7. ASTM E2189 – Standard Test Method for Testing Resistance to Fogging in Insulating Glass Units.
 - 8. ASTM E2190 – Standard Specification for Insulating Glass Unit Performance and Evaluation.

1.04 QUALITY ASSURANCE

- A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
- B. Source Limitation for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- C. Glass Product Testing: Obtain glass test results for product test reports in Submittals Article from a qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program

- D. Safety Glazing Labeling: Permanently mark glazing with certification label indicating manufacturer's name, type of glass, glass thickness and safety glazing standard with which glass complies.
- E. Installer Qualifications: An experienced installer who has completed glazing similar in material, design and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

- A. Provide in accordance with Section 01 33 00 Submittal Procedures.
- B. Provide for each glass type:
 - 1. Latest edition of manufacturer's Technical Data including structural, physical and environmental characteristics, size limitations, and special handling or installation requirements.
 - 2. Product Certificates from manufacturer.
 - 3. Product Test Reports for: Tinted Float Glass, Coated Float Glass, and Insulating Glass.
 - 4. Submit two, 12"x12" samples, illustrating glass unit and coloration.
- C. Provide data, including VOC content on glazing sealant. Identify colors available.
- D. Provide shop drawings: Submit shop drawings showing layout, profiled and product components.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Comply with the requirements of Section 01 66 00 Product Storage and Handling Requirements.
- B. 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.

1.08 PROJECT CONDITIONS

- A. Comply with the requirements of Section 01 50 00 Construction Facilities.
- B. Environmental Limitations: Do not deliver or install fire-resistant glazing until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature conditions at occupancy levels during the remainder of the construction period.

1.09 WARRANTY

- A. Provide Manufacturers Standard Warranty in accordance with Section 01 78 36 Warranties.
- B. Contractor shall guarantee the work covered by this specification against all defects in material and workmanship for a period of not less than FIVE (5) years. Include coverage of sealed glass units from seal failure, interpane dusting or misting, and replacement.

PART 2 – PRODUCTS

2.01 ACCEPTABLE GLASS MANUFACTURERS

- A. Insulated, Laminated, and Spandrel Glass: Vitro Architectural Glass (formerly PPG Industries), Tel: (800) 377-5267, Website: www.vitroglazings.com.
- B. Security Glazing: Nippon Electric Glass Company, Ltd.; Tel: (800) 426-0279.
- C. Fire-Rated Clear Window and/or Door/Sidelight Glazing: SAFTI FIRST, Tel: (888) 653-3333, Website www.safti.com.

2.02 GLASS MATERIALS

- A. General Performance Requirement: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.
- B. GE-1: Exterior Glazing Type 1, Insulated Glass Units.
 - 1. Unit Makeup: Double pane of 1/4" (6mm) outboard lite and 1/4" (6mm) inboard lite with edge seal; 1/2" (12mm) spacer purged with dry hermetic air; total unit thickness of 1 inch.
 - 2. Glass Strength: Tempered as required by codes or as required to meet thermal stress and wind loads.
 - 3. Coating: Low-E Coating on inside of outer layer (#2 surface).
 - 4. Tinting: As indicated on the Drawings.
 - 5. Spandrel Coating: As indicated on the Drawings.
 - 6. Performance values based on combination of coating and/or tint selected.
- C. GE-1: Exterior Glazing Type 2, Laminated Glass
 - 1. Unit Makeup: 9/16" thick Two-Ply Laminated Glass comprised of a 1/4" outer ply, 1/4" inner ply and an interlayer of 0.060" polyvinyl butyral (PVB) sheet. Product to be fabricated in autoclave with heat, plus pressure, free of foreign substances and air pockets.
 - 2. Glass Strength: Chemically strengthened. Safety rated in accordance with ANSI Z97.1 and CPSC 16 CFR 1201 Cat. I & II.
 - 3. Style: Clear, unless noted otherwise.
- D. GI-1: Interior Glazing Type 1
 - 1. Unit Makeup: Monolithic pane of 1/4" (6mm) lite.
 - 2. Glass Strength: Tempered (Grade B)
 - 3. Style: Clear, Uncoated, Type I (float or plate).
- E. GI-2: Interior Glazing Type 2, Fire-Rated
 - 1. Unit Makeup: Monolithic pane as required per Fire-Rated Assembly.
 - a. Nominal thickness per Fire Rating:
 - i. 1/4" (6mm) = 20 minute
 - ii. 3/4" (19mm) = 45 minute
 - iii. 7/8" (23mm) = 60 minute
 - iv. 1 7/16" (37mm) = 90 minute
 - v. 2 1/8" (54mm) = 120 minute
 - 2. Glass Strength: Tempered. Safety rated in accordance with ANSI Z97.1 and CPSC 16 CFR 1201 Cat. I & II.
 - 3. Style: Clear, float glass.
 - 4. Fire protective tested in accordance with NFPA 80, NFPA 252, NFPA 257, UL 9, UL 10B and UL10C.
- F. GI-3: Interior Glazing Type 3
 - 4. Unit Makeup: Monolithic pane of 1/2" (12mm) lite.

5. Glass Strength: Tempered (Grade B)
6. Style: Clear, Uncoated, Type I (float or plate).

2.03 GLAZING ACCESSORIES

- A. Select appropriate glazing sealants, tapes, gaskets and other glazing materials of proven compatibility with other materials that they contact. These include glass products, insulating glass unit seals and glazing channel substrates under installation and service conditions, as demonstrated by testing and field experience. Provide fire-rated products approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection rating indicated.
- B. Glazing Compound: Modified oil type, non-hardening, knife grade consistency.
- C. Butyl Sealant: Single component; Shore-A hardness of 10-20; black color; non-skinning.
- D. Acrylic Sealant: Single component, solvent curing, cured Shore hardness, non-bleeding.
- E. Silicone Sealant: Single component, non-bleeding, non-staining; capable of water immersion without loss of properties.
- F. Setting Blocks: Neoprene; 80-90 Shore A durometer hardness; 4 inch minimum long x 1/4 inch thick.
- G. Spacer Shims: Neoprene; 40-50 Shore A durometer hardness; 4 inch long on 18 inch centers for wet-glazed systems.
- H. Glazing Clips: Manufacturer's standard type.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine the area and conditions under which work of this Section will be performed and confirm site conditions are acceptable for installation of the glass.
- B. Coordinate work with other trades as needed to assure that proper substrate are provided to receive work of this Section.
- C. Verify openings for glazing are correctly sized and within tolerance.
- D. Verify surfaces of glazing channels or recesses are clean, square in plane, free of obstructions, and ready for work of this Section.
- E. Verify that a functioning weep system is present.
- F. Correct conditions detrimental to timely and proper completion of the Work.
- G. Do not proceed until unsatisfactory conditions are corrected.
- H. Beginning of installation means acceptance of conditions.

3.02 PREPARATION

- A. Protect glazing products by handling and storing units according to manufacturer's recommendations.
- B. Clean and prepare glazing channels and other framing members to receive glass.
- C. Remove coatings and other harmful materials that will prevent glass and glazing installation required to comply with performance criteria specified.
- D. Seal porous glazing channels or recesses.

3.03 EXTERIOR WET METHOD (SEALANT AND SEALANT)

- A. Place setting blocks at 1/4 points and install glass pane.

- B. Install removable stops with pane centered in space by inserting spacer shims both sides at 18-inch intervals, 1/4 inch below sightline.
- C. Fill gap between pane and stops with sealant to depth equal to bite of frame on pane, but not more than 3/8 inch below sightline.
- D. Apply sealant to uniform line, flush with sightline. Tool or wipe sealant surface with solvent for smooth appearance. Security Glazing to be sealed with security sealant as recommended by manufacturer.
- E. Drain or weep the sill of each opening to the outdoors at three points using 3/8-inch diameter weep holes or the equivalent.

3.04 INTERIOR COMBINATION METHOD (TAPE AND SEALANT)

- A. Cut glazing tape to length and install against permanent stops, project 1/16 inch above sightline.
- B. Place setting blocks at 1/4 points.
- C. Rest glass on setting blocks and push against tape to ensure full contact at perimeter of pane.
- D. Install: removable stops, spacer shims between glass, and applied stops at 18-inch intervals 1/4 inch below sightline.
- E. Fill gap between pane and applied stop with sealant to depth equal to bite of frame on pane to uniform and level line.
- F. Trim protruding tape edge.

3.05 INTERIOR WET METHOD (COMPOUND AND COMPOUND)

- A. Install glass resting on setting blocks. Install applied stop and center pane by use of spacer shims at 18-inch centers, kept 1/4 inch below sightline.
- B. Locate and secure glass pane using glaziers' clips.
- C. Fill gaps between pane and stops with glazing compound until flush with sightline.

3.06 CLEANING

- A. After installation, mark pane with an "X" by using plastic tape or removable paste.
- B. Remove glazing materials from finish surfaces.
- C. Remove labels after work is completed.
- D. Clean excess sealant or compound from glass and framing members immediately after application using solvents or cleaners recommended by manufacturers. Final cleaning and polishing shall be done prior to final inspection.
- E. Do not use scrapers or other metal tools to clean glass.
- F. Remove and replace broken, scratched, chipped or otherwise defective glass with new materials and leave the entire installation in a neat, clean, and acceptable condition.

END OF SECTION

SECTION 09 05 61.13

MOISTURE VAPOR EMISSION CONTROL

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 SCOPE OF WORK SUMMARY

- A. Pre-formed moisture suppression membrane installed over concrete subfloor as a floor covering underlayment.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- C. Coordinate the work of this section and directly related sections with concrete floor construction and repair.
- D. Coordinate the work of this section and directly related sections with finish flooring work.

1.03 REFERENCES

ASTM International

- A. D2646-05- Standard test Methods for Backing Fabric Characteristics of Pile Yarn Floor Coverings
- B. D3273-00- Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- C. D5729-97 (2004)e1 – Standard Test Method for Thickness of Nonwoven Fabrics
- D. E-96-05 – Standard Test Methods for Water Vapor Transmission of Materials
- E. F 2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
- F. F 710 - Standard Practice Preparing Concrete Floors

1.04 QUALITY ASSURANCE

Comply with the Standard requirements established by Manufacturer.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

- A. Provide in accordance with Section 01 33 00 Submittal Procedures.
- B. Product Data: Provide data indicating any product characteristics, performance criteria, and limitations of use.
- C. Manufacturer's Current Instructions.
- D. Manufacturer's warranty registration with concrete subfloor moisture test results and building ambient air temperature and relative humidity test results.

1.07 DELIVERY, STORAGE, AND HANDLING

Comply with the requirements of Section 01 66 00 Product Storage and Handling Requirements.

1.08 PROJECT CONDITIONS

- A. Comply with the requirements of Section 01 50 00 Construction Facilities.
- B. Comply with Manufacturer's Standard Requirements.

1.09 WARRANTY

- A. Provide Manufacturer's Standard Warranty in accordance with Section 01 78 36 Warranties.
- B. Provide Warranty duration based upon requirements of Flooring.

PART 2 – PRODUCTS

2.01 MANUFACTURER

Basis of Design: GCP Applied Technologies Inc. Kovara 95 & MBX (formerly VersaShield 95 & VersaShield MBX). Location: 62 Whittemore Avenue, Cambridge, MA 02140. Phone: 866-333-3726. Website: www.gcpat.com

2.02 MOISTURE SUPPRESSION SYSTEM FOR FLOORING PRODUCTS

- A. Product name: Kovara 95 Flooring Underlayment and Kovara MBX Flooring Underlayment.
 - 1. Material: Free-standing, dimensionally stable, 4-ply composite product, engineered as a moisture suppression membrane to be used on concrete floors where high moisture exists.
 - 2. Dimensions: 144 ft. long by 5 ft. wide standard roll.
 - 3. Mold, Mildew & Fungal Resistance, ASTM D3273: 10 rating
 - 4. Moisture Vapor Transmission rate, ASTM E96-05: less than 0.01 g/hr/sq m
- B. Accessories: Kovara Double-Sided Seam Tape
 - 1. Application: Joining of moisture suppression underlayment seams.
 - 2. Description: Membrane manufacturer's moisture suppression tape with double-sided pressure sensitive adhesive for use over slabs with a maximum relative humidity of 99.5 percent and maximum pH of 12.
 - 3. Properties: Moisture suppression and adhesion per manufacturer's specifications.
 - 4. Dimensions: 4 inch wide by 100 feet long roll.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify internal RH of the Concrete Sub Floor according to ASTM F-2170.
 - 1. Record readings and submit with manufacturer's warranty registration.
 - 2. Kovara 95: Do not install if relative humidity levels within the concrete exceed 95% Relative Humidity.
 - 3. Kovara MBX: Do not install if relative humidity levels within the concrete exceed 99% Relative Humidity.

3.02 PREPARATION

New or Remedial Installation - Concrete Sub Floor:

- A. Prepare floor according to Kovara 95 or Kovara MBX manufacturer's instructions including removal of existing materials on concrete surface, grinding protrusions flat, and filling low

spots with water-resistant cementitious patching or leveling compound. Patch cracks greater than 1/8-in. width using VersaShield manufacturer's approved crack mending compound.

- B. Remove debris and excessive dust from the surface.

3.03 UNDERLAYMENT INSTALLATION

- A. Install moisture suppression membrane with smooth film side facing concrete slab.
- B. Install in accordance with membrane manufacturer's current written installation instructions.
- C. If any jobsite condition interferes with compliance with manufacturer's instructions, contact manufacturer and obtain written job-specific procedures. Notify architect or owner's representative as required in the Quality Section of this project manual describing the interfering jobsite condition and manufacturer's job-specific instructions.

3.04 FLOORING INSTALLATION

- A. Adhesives - Apply adhesive to mineral-coated surface of moisture suppression membrane. Use only water-based adhesives. Do not use solvent-based adhesives.
- B. Protection - Protect moisture suppression membrane from damage during flooring installation. Do not tear, rip, puncture, or delaminate membrane when applying trowel-on adhesive. Repair damaged areas according to membrane manufacturer's instructions before flooring installation. Provide continuous, intact moisture suppression membrane under entire designated flooring area.
- C. Install flooring according to flooring manufacturer's instructions
 - 1. Laminate or Engineered Wood: Install according to manufacturer's instructions for floating floors.
 - 2. Broadloom Carpet or Carpet Tiles: Adhere directly to moisture suppression membrane using carpet manufacturer's recommended adhesive.
 - 3. Vinyl Tile: Adhere directly to moisture suppression membrane using tile manufacturer's recommended adhesive.
 - 4. Ceramic Tile: Adhere only to approved surfaces - concrete, plywood, precast flooring, gypcrete, radiant heated floors, existing well-bonded vinyl, VCT, LVT, LVP, metal floors, and chemically treated or contaminated surfaces.
- D. Not approved for unitary back direct glue wide width carpet, linoleum, rubber tile, sheet vinyl, mechanically fastened solid wood.

END OF SECTION

SECTION 09 21 13

PLASTER ASSEMBLIES

PART 1- GENERAL

1.01 SUMMARY

- A. Section Includes: Work includes all labor, materials, and equipment necessary to install all aspects of the portland cement plaster.

1.02 REFERENCES

- A. ASTM C150 – Portland Cement
- B. ASTM C847 – Standard Specification for Metal Lath
- C. ASTM C933 - Welded Wire Lath
- D. ASTM C926 – Application of Portland Cement-Based Plaster
- E. ASTM C1063 – Installation of Lathing and Furring for Portland Cement Based Plaster
- F. PCA (Portland Cement Association) – Plaster (Stucco) Manual
- G. Plaster and Drywall Systems Manual, Third Edition
- H. ICC-ES Acceptance Criteria for Weather-resistive Barriers (AC308)
- I. Omega Three Coat Systems Details (TCS)

1.03 SYSTEM DESCRIPTION

- A. General: Portland cement plaster is comprised of a water-resistive barrier, optional sheathing, metal lath, scratch and brown coats, and a finish coat.
- B. Application Methods: The plaster is applied directly to a structure at the construction site.

1.04 SUBMITTALS

- A. Product Data: All product data sheets, evaluation reports, details, and warranty information that pertain to the project in accordance with Section 01 30 00 Submittal Procedures.
- B. Samples: Submitted upon request.
 - 1. Samples of the finish coat shall be of an adequate size as required to represent each color and texture to be utilized on the project and produced using the same techniques and tools required to complete the project.
 - 2. Retain approved samples at the construction site throughout the application process.

1.05 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: System component materials shall be manufactured or approved by Omega Products International, and shall be distributed by the same or its authorized dealers.
- B. Plastering Contractor:
 - 1. Shall specialize in cement plasterwork with documented experience.
 - 2. Shall provide proof of current contractor's license and bond where required.
- C. On-Site Mockups: Produced upon request.
 - 1. Prior to commencement of work, provide a mockup for approval.

2. Mockup suitable to represent the products to be installed for each color and texture constructed using the same tools and techniques to be utilized on the project.
3. Retain approved mockup at job site throughout the application process.
 - a. Where acceptable to the architect, approved mockups may become part of the completed work if undisturbed at time of substantial completion.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver all materials to the construction site in their original, unopened packaging with labels intact.
- B. Inspection: Inspect the materials upon delivery to ensure that specified products have been received. Report defects or discrepancies to the responsible party according to the construction documents; do not use reported material for application.
- C. Storage: Store all products per manufacturer's recommendations. Generally, store materials in a cool, dry location; away from direct contact with the ground and/or concrete; out of direct sunlight; and protect from weather and other damage.

1.07 PROJECT CONDITIONS

- A. Environmental Requirements: Follow product manufacturer's recommendations for environmental conditions and surface preparation.
 1. Substrates: Prior to installation, inspect the wall for surface contamination or other defects that may adversely affect the performance of the materials and shall be free of residual moisture. Do not apply plaster to substrates whose temperatures are less than 40°F (4°C) or contain frost or ice.
 2. Inclement Weather: Protect applied material from inclement weather until dry.
- B. Existing Conditions:
 1. Jobsite Resources: Provide access to electrical outlets, clean, potable water, and a suitable work area at the construction site throughout the application of the portland cement plaster.

1.08 SEQUENCING AND SCHEDULING

- A. Sequencing: Coordinate the installation of the portland cement plaster with all other construction trades. To reduce the likelihood of the stucco cracking, it is recommended the building carry a minimum of 90 percent of the dead building load and the interior gypsum be installed prior to installation of the stucco.
- B. Staffing: Provide sufficient manpower to ensure continuous operation, free of cold joints, scaffolding lines, variations in texture, etc.

1.09 WARRANTY

- A. System Warranty: Submit documentation on standard system warranties. At completion of work, provide written system warranty documentation.
- B. Warranty Length: 15 years commencing at the time of substantial completion.

1.10 MAINTENANCE

- A. The following materials shall be presented to the owner following the application of the work:
 1. One container of finish for each color and texture utilized on the project.
 2. A maintenance program for finishes as required.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Omega Products International.
- B. Or Architect approved equal.

2.02 SCRATCH AND BROWN COAT

- A. Cement: A low alkali portland cement-based stucco complying with ASTM C150.
 - 1. Basis of Design: Super Cement with Fiber
- B. Sand:
 - 1. Sand must be clean and free from deleterious amounts of loam, clay, silt, soluble salts and organic matter.
 - 2. Sampling and testing must comply with ASTM C144 or C897.
- C. Water: Clean and potable without foreign matter.

2.03 BONDER

- A. Basis of Design: BondCrete

2.04 WATER-RESISTIVE BARRIER

- A. Refer to Sheet Weather Barrier Specification Section 07 25 00.

2.05 LATH

- A. Welded Wire: Nominal No. 17 gauge, 1.5-inch-by-1.5-inch opening, Class 1 galvanized steel complying with ASTM C933.

2.06 ACCESSORIES

- A. Lath and Accesesories: Confirm to ASTM C847, ASTM C933, ASTM C1032 and ASTM C1063 and Appendix
 - 1. Accessories: Manufacturer's standard steel products with minimum G60 galvanizing unless otherwise indicated as rigid polyvinyl chloride (PVC plastic) or zinc alloy.

2.07 CRACK ISOLATION SYSTEM

- A. Mesh: Alkali resistant, 4.5 oz., woven glass fiber fabrics specially manufactured by Omega Products International.
- B. Base coat: CI-Base manufactured by Omega Products International.

2.08 PRIMER

- A. RapidPrime primer manufactured by Omega Products International.

2.09 FINISHES

- A. OmegaFlex: 100% acrylic-based finish manufactured by Omega Products International.
- B. Color and Texture: Color and finish texture shall be as selected by the Architect.
 - 1. Finish coat to contain integral color. Submit samples to Architect for approval based upon colors indicated on Drawings

2.10 MIXES

- A. Cement Plaster: Mix and proportion cement plaster in accordance with ASTM C926 and local codes.

- B. Finishes: Mixing and tinting instructions are contained in the appropriate product data sheets by Omega Products International.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to the application of the cement plaster the plastering contractor shall ensure that:
 - 1. Surface and site conditions are ready to receive work.
 - 2. Grounds and Blocking: Verify that the items within the walls for other sections of work have been installed.
- B. Substrates:
 - 1. Acceptable substrates must be securely fastened per applicable building code requirements.
 - 2. Acceptable substrates and adjacent materials must be dry, clean, and sound. Substrate surface must be flat, free of fins or planar irregularities greater than ¼ inch in 10 feet (6mm in 3m).
- C. Flashings: All flashing around windows, at deck attachments, utility penetrations, roof lines, etc. and all kick-out flashing must be properly installed prior to application of the cement plaster.
- D. Unsatisfactory conditions shall be reported to the general contractor and/or builder and/or architect and/or owner. Do not proceed until all unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Substrate: Clean the substrate to which the plaster is to be applied, ensuring that there are no foreign materials present; including, but are not limited to, oil, dirt, dust form release agents, efflorescence, paint, wax, water repellants, moisture, frost, and or extended nails that may rupture the water-resistive barrier.
- B. Surrounding Areas: Protect surfaces near the work of this section from damage, disfiguration, and overspray. Mask off all dissimilar materials.

3.03 INSTALLATION, GENERAL

- A. General Installation: Refer to ASTM C926, ASTM C1063, and/or the appropriate manufacturer's product data sheet for additional installation requirements and recommendations.

3.04 INSTALLING WEATHER PROTECTION

- A. Water-Resistive Barrier: Apply water-resistive barrier complying with Section 1404.2 of the IBC or Section R703.2 of the IRC, as applicable.

3.05 INSTALLING LATH

- A. General: Installed per ASTM C1063.

3.06 INSTALLING CEMENT PLASTER

- A. Application Over Metal Lath: Apply per ASTM C926 and C1063. Apply portland cement plaster by hand-troweling or machine-spraying to a nominal thickness of 3/8-inch (9.5mm) scratch coat and to a nominal thickness of 3/8-inch (9.5 mm) brown coat.
- B. Moist Curing: Moist curing is a critical step in the plaster system application. Provide sufficient moisture by fog or moist curing to permit proper hydration of the cementitious materials. The length of time and most effective procedure for curing will depend on climatic and job conditions.

3.07 INSTALLING CRACK ISOLATION SYSTEM

- A. After brown coat has properly cured, apply base coat to wall and fully embed mesh into base coat. See the appropriate Omega product data sheet for mixing and application instruction. A minimum two-inch (51 mm) overlap is required at all mesh joints. Base coat surface shall be left suitable for the application of the finish.

3.08 INSTALLING FINISH COAT

- A. General: Apply per manufacturer's product data sheet.
- B. Verification: Verify the desired color and texture match the approved sample and/or mockup prior to installation.

3.09 CLEANING

- A. Cleaning: Remove any and all materials used, overspray from adjacent surfaces, and all protective masking.

3.10 PROTECTION

- A. Protection: Protect applied material from inclement weather until dry and prevent it from freezing for a minimum of 24 hours after set and/or until dry. Refer to manufacturer's product data sheet for additional requirements.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Requirements apply to this Section.

1.02 SCOPE OF WORK SUMMARY

Supply and install all Gypsum Board Products, as shown on Drawings and as specified herein, including all accessories and labor for a timely, complete, and proper installation

- A. Fire-Resistance Rated Gypsum Board
- B. Mold and Moisture Resistant Gypsum Board
- C. Fire-Resistance, Mold and Moisture Resistant Gypsum Board
- D. Abuse Resistant Gypsum Board
- E. Impact Resistant Gypsum Board
- F. Cement Board

1.03 STANDARDS AND REFERENCES

Comply with the Industry Standards and References as established by Manufacturer.

1.04 QUALITY ASSURANCE

- A. Comply with the Standard requirements established by Manufacturer.
- B. Abuse Resistant Gypsum Board Performance Criteria:

1. Classification:

- a. Surface Abrasion: Level 1-3
- b. Surface Indention: Level 1
- c. Soft Body Impact: Level 1-2

2. Wall Assembly Fire-Resistance Rating: locations per the drawings.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

Provide in accordance with Section 01 33 00 Submittal Procedures.

1.07 DELIVERY, STORAGE, AND HANDLING

Comply with the requirements of Section 01 66 00 Product Storage and Handling Requirements.

1.08 PROJECT CONDITIONS

Comply with the requirements of Sections 01 50 00 Construction Facilities.

1.09 WARRANTY

Provide Standard Warranty in accordance with Section 01 78 36 Warranties.

PART 2 - PRODUCTS

2.01 MANUFACTURER / PRODUCTS

Basis of Design: Products of National Gypsum Company

2.02 FIRE-RESISTANCE RATED GYPSUM BOARD

A. Basis of Design: Gold Bond® BRAND Fire-Shield C Gypsum Board.

B. Panel Physical Characteristics:

1. Core: Enhanced fire-resistance rated gypsum core
2. Surface paper: 100% recycled content paper on front, back and long edges
3. Long Edges: Square or Tapered at Contractor's discretion.
4. Overall thickness: 5/8 inch.
5. Panel complies with Type X requirements of ASTM C 1396 Standard Specification for Gypsum Board

2.03 MOLD AND MOISTURE RESISTANT GYPSUM BOARD

A. Basis of Design: Gold Bond® BRAND XP® Gypsum Board

B. Panel Physical Characteristics

1. Core: Mold and moisture resistant gypsum core.
2. Surface paper: 100% recycled content moisture/mold/mildew resistant paper on front, back, and long edges.
3. Long Edges: Square or Tapered at Contractor's discretion.
4. Overall thickness: 5/8 inch.
5. Panel complies with requirements of ASTM C 1396 Standard Specification for Gypsum Board.
6. Mold/Mildew Resistance: 10 when tested in accordance with ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

2.04 FIRE-RESISTANCE RATED GYPSUM BOARD WITH ENHANCED MOLD AND MILDEW RESISTANCE

A. Basis of Design: Gold Bond® BRAND XP® Fire-Shield® C Gypsum Board

B. Type C, Panel Physical Characteristics

1. Core: Mold and moisture resistant, with enhanced fire-resistance rated gypsum core
2. Surface paper: 100% recycled content moisture/mold/mildew paper on front, back and long edges
3. Long Edges: Square or Tapered at Contractor's discretion.
4. Overall thickness: 5/8 inch.
5. Panel complies with requirements Type X of ASTM C 1396 Standard Specification for Gypsum Board
6. Mold/Mildew Resistance: 10 when tested in accordance with ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

2.05 ABUSE RESISTANT GYPSUM BOARD

A. Basis of Design: Gold Bond® BRAND Hi-Abuse® XP® Gypsum Board

B. Panel Physical Characteristics

1. Core: Fire resistance rated gypsum core, with additives to enhance, surface indentation resistance and impact resistance.
2. Surface paper: Abrasion resistant, 100% recycled content moisture/mold/mildew resistant paper on front, back and long edges
3. Long Edges: Square or Tapered at Contractor's discretion.
4. Overall thickness: 5/8 inch.
5. Panel complies with Type X requirements ASTM C 1396 Standard Specification for Gypsum Board.
6. Surface Abrasion Resistance: 0.009 inch when tested in accordance with ASTM D 4977 Standard Test Method for Granule Adhesion to Mineral Surfaced Roofing by Abrasion
7. Indentation Resistance: 0.132 inch when tested in accordance with ASTM D 5420 Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
8. Soft Body Impact: 210 ft-lbf when tested in accordance with ASTM E 695 Standard Method for Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading
9. Mold/Mildew Resistance: score of 10 when tested in accordance with ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

2.06 CEMENT BOARD

A. Cement Backerboard

1. Basis of Design: PermaBase® BRAND Cement Board

2. Panel Physical Characteristics

- a. Core: Cementitious, water-durable
- b. Surface: Fiberglass mesh on front and back
- c. Long Edges: Tapered
- d. Overall Thickness: 5/8 inch.
- e. Panel complies with requirements of ASTM C 1325 Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units and ANSI A118.9
- f. Density: 72 lbs. per cu. ft.
- g. Water Absorption: Not greater than 8% when tested for 24 hours in accordance with ASTM C 473 Standard Test Methods for Physical Testing of Gypsum Panel Products

B. Cement Board Underlayment

1. Basis of Design: PermaBase® BRAND Cement Board

2. Panel Physical Characteristics

- a. Core: Cementitious, water-durable

- b. Surface: Fiberglass mesh on front and back
- c. Long Edges: Tapered
- d. Overall Thickness: 1/4 inch
- e. Panel complies with requirements of ASTM C 1325 and ANSI A118.9
- f. Density: 72 lbs per cu. ft.
- g. Water Absorption: Not greater than 8% when tested for 24 hours in accordance with ASTM C 473 Standard Test Methods for Physical Testing of Gypsum Panel Products

2.07 HIGH IMPACT GYPSUM BOARD

A. Basis of Design: Gold Bond® BRAND Hi-Impact® XP® Gypsum Board

- 1. Performance Criteria - Wall Assembly STC: 40
- 2. Panel Physical Characteristics
 - a. Core: Fire-resistance rated gypsum core, with additives to enhance mold/mildew resistance, surface indentation resistance, impact resistance and moisture and mold resistant
 - b. Surface paper: Abrasion resistant, 100 percent recycled content moisture/mold/mildew resistant paper on front, back and long edges
 - c. Embedded fiberglass mesh
 - d. Long Edges: Tapered
 - e. Overall thickness: 5/8 inch
 - f. Panel complies with Type X requirements of ASTM C 1396
 - g. Surface Abrasion Resistance: Classification Level 3 in accordance with ASTM C 1629
 - h. Indentation Resistance: Classification Level 1 in accordance with ASTM C 1629.
 - i. Soft Body Impact Resistance: Classification Level 3 in accordance with ASTM C 1629
 - j. Hard Body Impact Resistance: Classification Level 3 in accordance with ASTM C 1629.
 - k. Mold/Mildew Resistance: 10 when tested in accordance with ASTM D 3273.

2.08 ACCESSORY PRODUCTS

A. Acoustical sealant

- 1. Conform to ASTM C 919 Standard Practice for Use of Sealants in Acoustical Applications
- 2. Products/Manufacturer
 - a. Grabber Acoustical Sealant GSC
 - b. STI SpecSeal Smoke N Sound Caulk
 - c. BOSS 824 Acoustical Sound Sealant

B. Firestopping

- 1. Conform to ASTM E 90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

- 2. Products/Manufacturer
 - a. STI SpecSeal SSP Putty Pads
 - b. BOSS 818 Fire Rated Putty Pads
- C. Fasteners for use with 5/8 inch thick tile backer panels: As recommended by Manufacturer.
- D. Fasteners for use with Cement Board:
 - 1. PermaBase Cement Board Hi-Lo thread screws (No. 8).
 - 2. Wafer head, corrosion-resistant.
 - 3. Overall Thickness: As recommended by Manufacturer.
 - 4. For use with wood framing and complying with ASTM C 1002 Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- E. Joint Treatment
 - 1. Tape - As recommended by Manufacturer:
 - a. Paper Tape: 2-1/16 inches wide.
 - b. Paper Tape: 2 inches wide with metal strips laminated along the center crease to form inside and outside corners.
 - c. Fiberglass Tape: Nominal 2 inches wide self-adhering tape.
 - d. Alkali-resistant Fiberglass Tape: Nominal 2 inches wide polymer coated alkali-resistant mesh tape.
 - 2. Drying Type Compound - As recommended by Manufacturer:
 - a. Ready Mix vinyl base compound.
 - b. Ready Mix vinyl base compound formulated for enhanced mold and mildew resistance.
 - c. Ready Mix vinyl base compound formulated to reduce airborne dust during sanding.
 - d. Ready Mix vinyl base topping compound for finish coating.
 - e. Ready Mix vinyl base compound for embedding joint tape, corner beads or other accessories.
 - f. Field Mix vinyl base compound.
 - 3. Setting Compound - As recommended by Manufacturer:
 - a. Field mixed hardening compound.
 - b. Field mixed hardening compound for fire resistance rated construction and penetrations.
 - 4. Joint Sealant: Conform to ASTM C920 Standard Specification for Elastomeric Joint Sealants.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas to receive gypsum products to verify conditions.
- B. Report conditions contrary to contract requirements that would prevent a proper installation.

- C. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- D. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the conditions.
- E. Installation indicates acceptance of the conditions with regard to conditions existing at the time of installation.

3.02 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840, GA-216 or GA-214.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panel not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4 to 3/8 inch (6 to 9 mm) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4 to 1/2 inch (6 to 12 mm) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.03 INSTALLATION, INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Regular Type: Vertical or horizontal surfaces, unless otherwise indicated.
 - 2. Type X: Where required for fire-resistance-rated assembly.
 - 3. Type C: Where required for specific fire-resistance-rated assembly indicated.
 - 4. Ceiling Type: Ceiling surfaces.
 - 5. Moisture and Mold-Resistant Type: Areas with limited exposure to water.
 - 6. High Impact Type: As indicated on Drawings.
 - 7. Abuse Resistant Type: As indicated on Drawings.
- B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
3. On furring members, apply gypsum panels vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.04 INSTALLATION, CEMENT BOARD PANELS

- A. Install in accordance with manufacturer recommendation and ANSI A108.11.
- B. Install where tile finish is indicated in the Drawings.
- C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.05 INSTALLATION, TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings and if not shown according to ASTM C 840 or GA-216 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations

1. Cornerbead: Use at outside corners, unless otherwise indicated. Install standard 90 degree cornerbeads where corner guards and chair rails are to be installed.
2. LC-Bead: Use at exposed panel edges.

3.06 FINISHING GYPSUM BOARD

Provide a Level 4 Finish, with a light orange-peel texture. All joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. All joint compounds shall be smooth and free from tool marks and ridges. The prepared surface shall be coated with Sheet Rock Brand First Coat Primer, or equal, prior to the application of the light orange-peel texture.

3.07 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 SCOPE OF WORK SUMMARY

Supply and install all Acoustical Ceiling Work, as shown on Drawings and as specified herein, including all materials and labor for a timely, complete, and proper installation

1.03 STANDARDS AND REFERENCES

Comply with the Industry Standards and References as established by Manufacturer.

1.04 QUALITY ASSURANCE

- A. Have applicators approved by manufacturer of material or system being installed.
- B. Work hereunder requires coordination with trades who's Work connects with, is affected, or concealed by acoustical units. Before proceeding with Work, make certain all required inspections have been made.
- C. Examine sub-surfaces to receive Work. Commencement of Work will be construed as acceptance of all sub-surfaces.
- D. Comply with all applicable requirements of Acoustical Materials Association, Bulletin "Architectural Acoustical Materials".

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

- A. Provide in accordance with Section 01 33 00 Submittal Procedures.
- B. Submit complete layout of all systems including attachments, intersections of members and edge conditions.
- C. Samples: submit 2 samples of each type of unit specified herein.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of Section 01 66 00 Product Storage and Handling Requirements.
- B. Deliver all manufactured materials in original containers bearing manufacturer's name and brand. Use only one brand for each type of unit throughout job. Store materials within building in locations directed.

1.08 PROJECT CONDITIONS

- A. Comply with Manufacturer's Standard Requirements.

1.09 OPERATION AND MAINTENANCE DATA

Provide in accordance with Section 01 77 00 Project Closeout.

1.10 EXTRA MATERIALS

Comply with the requirements of Section 01 77 00 Project Closeout.

1.11 RECORD DRAWINGS

Provide in accordance with Section 01 77 00 Project Closeout.

1.12 WARRANTY

Provide Manufacturer's Standard Warranty in accordance with Section 01 78 36 Warranties.

PART 2 – PRODUCTS

2.01 SUSPENSION GRID

- A. Ceiling Suspension Materials: Comply with ASTM C635, as applicable to the type of suspension system required for the type of ceiling units indicated. Coordinate with other work supported by or penetrating through the ceilings.
- B. Manufacturer, Type, Location, and Pattern: as indicated on the drawings.
- C. Edge Mouldings: Manufacturer's standard channel moulding for edges and penetrations of ceiling, with a single flange of moulding exposed, white baked enamel finish, unless otherwise indicated.

2.02 ACOUSTICAL TILE

- A. Manufacturer, Type, Location, and Pattern: as indicated on the drawings.
- B. Substitutions: As approved by Architect.

2.03 EXTRA STOCK

Order additional 3% of each type, with one box minimum, of acoustical unit specified, for maintenance use, at no additional cost to Owner.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Installer must examine the conditions under which the acoustical ceiling work is to be performed and notify the Contractor in writing of any unsatisfactory conditions. This installer shall make sure all unsatisfactory conditions have been corrected in a manner acceptable to the installer before proceeding with Work.
- B. Provide all materials and accessories for complete installation per Drawings and manufacturer's printed instructions and recommendations.
- C. Install units to sub-surfaces from setout points and to pattern shown on Drawings. Verify location of Work of other trades so their items occur within a whole unit or at joints as shown.
- D. Install units in place fitting snugly. Provide spacers or hold-down clips where shown or required.
- E. After installation, clean any soiled surfaces. Replace any damaged units at no additional cost to the Owner.
- F. Arrange acoustical units in the manner shown by reflected ceiling plans. Consult with Architect pertaining to any adjustments.

3.02 SUPPORT SYSTEMS FOR SUSPENDED CEILING

- A. General: Ceilings shall not support material or building components other than grills, insulation batts or light fixtures. Duct work, plumbing and like work shall have its own support system and shall not use the ceiling system or suspension wires.
- B. Vertical Support System: Suspension wires shall be a minimum of 12-gauge galvanized wire attached to the main runner at 4 ft. maximum spacing in both directions. Each wire shall be anchored to the structure above with a device capable of supporting a minimum of 75 pounds. Wires supporting fixtures shall be capable of supporting four times the fixture weight. Suspension wires shall not hang more than 1 in 6 out of plumb unless counter sloping wires are provided. Wires shall not attach to or bond around interfering material such as ductwork. Trapeze or equivalent devices shall be used where obstructions interfere with direct suspension.
- C. Horizontal Support System: The lateral support system for ceilings shall be shown in detail shop Drawings. Provisions shall be made for possible differential movement between ceilings and sidewalls. Terminal ends of each main and each cross runner shall be wire supported; wall trim angles shall not provide primary support for runners. Lateral support of ceilings shall not be provided by the angle trim and runner shall not be riveted to wall trim.
- D. Light Fixture Support: All recessed or drop-in light fixtures shall be supported directly from the fixture housing to the structure above with a minimum of two 12 gauge wires; leveling and positioning of fixture may be provided by the ceiling grid. Fixture support wires may be slightly loose to allow fixture to seat in heavy-duty grid system only.
- E. Secure wire hangers by looping and wire tying either directly to structures or to inserts, eye-screws or other devices which are secure and appropriate for the substrate, and which will not deteriorate or fail with age or elevated temperatures.

3.03 CLEANING AND PROTECTION

- A. Clean exposed surfaces of acoustical ceilings, including trim, edge mouldings and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.
- B. The installer shall advise the Contractor of required protection for the acoustical ceilings, including temperature and humidity limitations and dust control, so that the Work will be without damage and deterioration at the time of acceptance by the Owner.

END OF SECTION

SECTION 09 51 53

DIRECT-ATTACHED ACOUSTICAL CEILING

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 SCOPE OF WORK SUMMARY

A. Section Includes

1. Acoustical ceiling panels
2. Exposed grid suspension system
3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
4. Perimeter Trim

1.03 REFERENCES

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

1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
7. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
8. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
9. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
10. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems
11. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
12. ASTM E 1264 Classification for Acoustical Ceiling Products

B. International Building Code

C. ASHRAE Standard 62.1-2004, Ventilation for Acceptable Indoor Air Quality

D. NFPA 70 National Electrical Code

- E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
 - F. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
 - G. International Code Council-Evaluation Services Report - Seismic Engineer Report
 - 1. ESR 1308 - Armstrong Suspension Systems
 - H. International Association of Plumbing and Mechanical Officials - Seismic Engineer Report
 - 1. 0244 - Armstrong Single Span Suspension System
 - I. California Department of Public Health CDPH/EHLB/Standard Method v1.2 2017
- 1.04 SYSTEM DESCRIPTION
- A. Continuous/Wall-to-wall
- 1.05 SUBMITTALS
- A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.
 - B. Samples: Minimum 6-inch x 6-inch samples of specified acoustical panel; 8-inch-long samples of exposed wall molding and suspension system, including main runner and 4-foot cross tees.
 - C. Shop Drawings: Layout and details of acoustical ceilings show locations of items that are to be coordinated with or supported by the ceilings.
 - D. Acoustical Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification, such as Underwriter's Laboratory (UL), of NRC, CAC, and AC.
 - 1. If the material supplied by the acoustical subcontractor does not have an independent laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of, and replaced with complying product at the expense of the Contractor performing the work.
- 1.06 QUALITY ASSURANCE
- A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer to ensure fit and function.
 - B. Installer Qualifications: Company specializing in performing specified work type, a minimum of three years of documented experience, and approved by the manufacturer.
 - C. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
 - D. Surface Burning Characteristics: Tested per ASTM E 84 and complying with ASTM E 1264 Classification.
- 1.07 DELIVERY, STORAGE, AND HANDLING
- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

- B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.08 PROJECT CONDITIONS

A. Space Enclosure:

- 1. HumiGuard Plus Ceilings: Building areas to receive ceilings shall be free of construction dust and debris. Products with HumiGuard Plus performance and hot dipped galvanized steel, aluminum or stainless-steel suspension systems can be installed up to 120°F (49°C) and in spaces before the building is enclosed, where HVAC systems are cycled or not operating. Cannot be used in exterior applications where standing water is present or where moisture will come in direct contact with the ceiling.

1.09 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

- 1. Acoustical Panels with HumiGuard® Max and HumiGuard® Plus performance: sagging and warping
- 2. Acoustical panels with BioBlock® performance: growth of mold and mildew
- 3. Grid System: rusting and manufacturer's defects

B. Warranty Period:

- 1. Ceiling System: Thirty (30) years from date of substantial completion

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.010 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.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Ceiling Panels:

- 1. Basis of Design: Armstrong World Industries, Inc.

B. Suspension Systems:

- 1. Basis of Design: Armstrong World Industries, Inc.

2.02 ACOUSTICAL CEILING UNITS

A. Acoustical Panel Ceilings

- 1. Surface Texture: Smooth Texture

2. Composition: Fiberglass with Plant Based Binder
3. Color: White
4. Size: 24 in x 72 in
5. Edge Profile: Square All-Sides
6. Noise Reduction Coefficient (NRC) ASTM C 423 Classified w/ UL label on product carton: 0.95,0.80
7. Flame Spread: ASTM E 1264; Class A
8. Light Reflectance (LR) White Panel: ASTM E 1477; 0.88
9. Dimensional Stability: HumiGuard Plus
10. Recycle Content: Up to 71% total recycled content. (Total recycled content: pre-consumer, post-consumer and post-industrial)
11. Material Ingredient Transparency: Health Product Declaration (HPD); Declare Label
12. Life Cycle Assessment: Third Party Certified Environmental Product Declaration (EPD)
13. Indoor Air Quality Certified to SCS-105 v4.2-2023
14. Basis of Design: LYRA PB Direct Apply, ITEM 8403PB as manufactured by Armstrong World Industries, Inc.

B. Attachment Devices: Adhesive – TiteBond® GREENChoice Acoustical Ceiling Tile Adhesive

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

3.02 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.
- B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.
 1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

3.03 INSTALLATION

- A. Follow manufacturer installation instructions.

3.04 ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.
- B. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove any ceiling products that cannot be successfully cleaned and or repaired. Replace with attic stock or new product to eliminate evidence of damage.

END OF SECTION

SECTION 09 65 00

RESILIENT FLOORING AND BASE

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 SCOPE OF WORK SUMMARY

- A. Supply and install all Resilient Flooring and Base, as shown on Drawings and as specified herein, including all materials and labor for a timely, complete, and proper installation.
- B. Work includes, but not limited to these major items:
 - 1. Resilient tile flooring.
 - 2. Floor substrate surface.
 - 3. Rubber base.

1.03 STANDARDS AND REFERENCES

Comply with the Industry Standards and References as established by Manufacturer.

1.04 QUALITY ASSURANCE

Conform to applicable code for flame rating requirements of 75 or less in accordance with ASTM E84.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

- A. Provide in accordance with Section 01 33 00 Submittal Procedures.
- B. Provide product data on specified products, describing physical and performance characteristics.
- C. Submit two samples, illustrating color and pattern for each floor material or base, substituted for those indicated in the Drawings.
- D. Submit manufacturer's installation instructions. When approved by the Architect, will become the basis for accepting or rejecting actual installation procedure used on the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

Comply with the requirements of Section 01 66 00 Product Storage and Handling Requirements.

1.08 PROJECT CONDITIONS

- A. Comply with the requirements of Section 01 50 00 Construction Facilities.
- B. Store materials for three days prior to installation in area of installation to achieve temperature stability.
- C. Maintain ambient temperature required by adhesive manufacturer three days prior to, during, and 24 hours after installation of materials.

1.09 OPERATION AND MAINTENANCE DATA

- A. Provide in accordance with Section 01 77 00 Project Closeout.

- B. Submit cleaning and maintenance data maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.10 EXTRA MATERIALS

- A. Provide in accordance with Section 01 77 00 Project Closeout.
- B. Provide 5% of each pattern and color of flooring and of base specified.

1.11 WARRANTY

- A. Provide Warranty in accordance with Section 01 78 36 Warranties.
- B. Duration: Manufacturer's 10-Year Commercial Limited Warranty.

PART 2 – PRODUCTS

2.01 RESILIENT PLANK/TILE

Manufacturer(s), Type(s), Location(s), Color(s), and Pattern(s) as indicated on drawings.

2.02 BASE MATERIALS

Manufacturer(s), Type(s), Location(s), Color(s), and Pattern(s) as indicated on drawings.

2.03 FLOORING TRANSITIONS

Manufacturer(s), Type(s), Location(s), Color(s), and Pattern(s) as indicated on drawings.

2.04 OTHER ACCESSORIES

- A. Subfloor Filler: Latex cement underlayment as recommended by flooring material manufacturer.
- B. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.
- C. Sealer and Wax: Types recommended by flooring manufacturer.
- D. Provide other materials, not specifically described but required for a complete and proper installation as selected by the Contractor subject to the approval of the Architect.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which work of this Section will be performed.
- B. Verify that surfaces are smooth and flat with maximum variation of 1/8 inch in 10 ft. and are ready to receive work.
- C. According to Section 07 05 00, verify that concrete floors are dry to the maximum moisture content of 2.5% (two and one half percent); and exhibit negative alkalinity, carbonization, or dusting. Higher moisture content will be as accepted by manufacturer in their written warranty.
- D. Correct conditions detrimental to timely and proper completion of the Work.
- E. Do not proceed until unsatisfactory conditions are corrected.
- F. Beginning of installation means acceptance of conditions.

3.02 PREPARATION

- A. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with sub-floor filler.

- B. Apply, trowel, and float filler to leave smooth, flat, hard surface.
- C. Prohibit traffic from area until filler is cured.
- D. Vacuum clean substrate.
- E. Maintain the temperature of the space to receive the flooring and the materials to be installed at a minimum of 65 degrees F and maximum of 100 degrees F for at least 48 hours prior to, during, and 48 hours after installation. Maintain a minimum temperature of 55 degrees F thereafter.
- F. Install flooring after all other trades, including painting, have been completed.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, conventional full-spread system.
- B. Spread only enough adhesive to permit installation of materials before initial set.
- C. Set flooring in place; press with heavy roller to attain full adhesion.
- D. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.
- E. Install edge strips at unprotected or exposed edges, and where flooring terminates.
- F. Scribe flooring to walls, columns, permanent cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION -- BASE MATERIAL

- A. Fit joints tight and vertical. Maintain minimum measurement of 18 inches between joints.
- B. Miter internal corners. At external corners, "V" cut back of base strip to 2/3 of thickness and fold.
- C. Install base on solid backing. Bond tight to wall and floor surfaces.
- D. Scribe and fit to doorframes and other interruptions.

3.05 PROTECTION

Prohibit traffic on floor finish for 48 hours after installation.

3.06 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean, seal, and wax floor and base surfaces in accordance with manufacturer's instructions.

END OF SECTION

SECTION 09 68 00

CARPETING

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Requirements apply to this Section.

1.02 SCOPE OF WORK SUMMARY

Furnish all Materials and perform labor required to execute this work as indicated on the drawings, as specified and as necessary to comply with the Contract Documents, including, but not limited to, these major items:

- A. Direct glue down carpet with backing.
- B. Metal edge trim and backing for carpet coved wall base if indicated on the drawings.

1.03 STANDARDS AND REFERENCES

Comply with the Industry Standards and References as established by Manufacturer.

1.04 QUALITY ASSURANCE

Comply with the Standard requirements established by Manufacturer.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

- A. Provide in accordance with Section 01 33 00 Submittal Procedures.
- B. Submit the following:
 - 1. Product data on specified products, describing physical and performance characteristics: sizes, patterns, colors available, and method of installation.
 - 2. Samples illustrating color and pattern for each carpet material specified if substituting from color board.
 - 3. Manufacturer's installation instructions. When approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on this Work.
 - 4. Acceptance of conditions of testing of Flooring Substrate for requirements prior to installation according to Section 07 05 00.

1.07 DELIVERY, STORAGE, AND HANDLING

Comply with the requirements of Section 01 66 00 Product Storage and Handling Requirements.

1.08 PROJECT CONDITIONS

- A. Comply with the requirements of Section 01 50 00 Construction Facilities.
- B. Store materials for three days prior to installation in area of installation to achieve temperature stability.
- C. Maintain minimum 72 degrees F ambient temperature plus/minus 5 degrees with relative humidity not exceeding 65% three days prior to, during, and 72 hours after installation of materials.

1.09 OPERATION AND MAINTENANCE DATA

- A. Provide in accordance with Section 01 77 00 Project Closeout.
- B. Submit operation and maintenance data maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning and shampooing.

1.10 EXTRA MATERIALS

- A. Provide in accordance with Section 01 77 00 Project Closeout.
- B. Provide an extra 5% of carpeting of each color specified.

1.11 WARRANTY

- A. Provide Manufacturer's Standard Warranty in accordance with Section 01 78 36 Warranties.
- B. Provide Manufacturer's Lifetime Commercial Limited Warranty.

PART 2 – PRODUCTS

2.01 CARPET

Manufacturer(s), Type(s), Location(s), Pattern(s), and Color(s) as indicated on drawings.

2.02 FLOORING TRANSITIONS

Manufacturer(s), Type(s), Location(s), Finishes(s), as indicated on drawings.

2.03 OTHER ACCESSORIES

- A. Sub-Floor Filler: White premix latex; type recommended by carpet manufacturer.
- B. Primers and Adhesives: Waterproof; of types recommended by carpet manufacturer.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which work of this Section will be performed.
- B. Correct conditions detrimental to timely and proper completion of the Work.
- C. Verify that substrate surfaces are smooth and flat with maximum variation of 1/8 inch in 10 ft. and are ready to receive work. Have all previous adhesives removed.
- D. Concrete Slab Testing:
 - 1. Alkalinity: Test the concrete for alkalinity prior to beginning the installation. Check the concrete for surface pH at several locations. A reading below 5.0 or above 9.0 requires corrective measures. Specific information on the correct method of neutralizing low or high pH is available through Shaw Technical Services Department.
 - 2. Moisture: Check the concrete for moisture at several locations using the anhydrous calcium test kits. The moisture transmission rate must not exceed 5.0 pounds per 1000 square-feet per 24-hours. Do not begin the installation if an unacceptable moisture level is detected. Do not use other methods of moisture testing as they are not reliable. If excessive moisture is present, advise the Construction Manager.
- E. Do not proceed until unsatisfactory conditions are corrected.
- F. Beginning of installation means acceptance of conditions.

3.02 PREPARATION

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

3.03 INSTALLATION

- A. Apply carpet and adhesive in accordance with manufacturers' instructions. Direct glue-down.
- B. Lay out rolls of carpet.
- C. Verify carpet match before cutting to ensure minimal variation between dye lots.
- D. Locate seams in area of least traffic. Carpet shall be installed in full lengths wherever possible.
- E. Fit seams straight, not crowded or peaked, free of gaps.
- F. Lay carpet on floors with run of pile in same direction as anticipated traffic. Lay carpet so that seams perpendicular to a wall do not occur at door openings in that wall.
- G. Do not change run of pile in any room where carpet is continuous through a wall opening into another room. Locate change of color or pattern between rooms under door centerline.
- H. Cut and fit carpet around interruptions.
- I. Fit carpet tight to intersection with vertical surfaces without gaps.
- J. All seams shall be beaded and sealed with "seam sealer". The seam sealer shall be applied to the cut edge of the carpet at the level of the carpet backing.
- K. No stretching will be permitted.
- L. Unroll carpet face up and cut the lengths required with pile-lay runs in the same direction. Check starting wall for squareness and allow for off-square walls. Strike chalk line the entire length of area where seam falls.
- M. Place two lengths in proper position for installing; trim salvage, and line up seam edge with chalk line. Lay carpet perfectly flat and tension free.
- N. Roll both widths back 3' from seam area the entire length of carpet.
- O. Spread adhesive from approximate center towards each end.
- P. When sufficient floor area has been covered with adhesive, drop or roll first width into place. Apply coating of edge sealer to seam edge of first width. Follow this procedure on each succeeding width at seam. Drop or roll second width into position and fit the seam in tightly using knee-kicker if necessary. Brush or roll looseness and air bubbles away from seam.
- Q. Fold or roll the remaining portion of the first width from the wall. Apply adhesive to the floor and drop or roll carpet into place.
- R. Roll or fold back dry portion of second width towards seam; spread adhesive and place carpet 3' from where next seam will fall.
- S. Brush or roll out looseness and air bubbles as carpet is put into place. Repeat above procedure on continuing widths. Trim carpet at wall using razor blade knife or suitable wall trimmer.

3.04 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean and vacuum carpet surfaces.

3.05 PROTECTION

- A. Prohibit traffic from carpet areas for 24 hours after installation.
- B. Cover with non-staining building paper, firmly fastened down to protect floor surfaces.
- C. Near completion of the project, remove paper, clean and vacuum carpet.

END OF SECTION

SECTION 09 78 19

WALL COVERING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Division 0, Contract Requirements and Division 1, General Requirements apply to this Section.

1.02 SCOPE OF WORK SUMMARY

- A. Section Includes: Interior concrete wall paneling.

1.03 REFERENCE STANDARDS

- A. ASTM E84/ UL 723 – Standard Test Method for Surface Burning Characteristics of Building Materials

1.04 SUBMITTALS

- A. Submit:
 - 1. Manufacturer's product data, and installation instructions for panels, adhesives, repair and cleaning products.
 - 2. Submit sample copy of manufacturer's warranty.
 - 3. Samples for Color Selection: Submit samples of manufacturer's standard colors.
 - 4. Samples of Verification: Submit sample of specified colors.
 - 5. Letter from paneling manufacturer stating acceptability of installer.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Materials: Submit eight pieces of each type of wall paneling.
- B. Repair Materials: Submit 100 ml of each component and color.

1.06 QUALITY ASSURANCE

- A. Mock-Ups:
 - 1. Provide mock-up at location indicated by Architect showing installation methods to be used.
 - 2. Approved mock-up may remain as part of completed construction.
- B. Installer: Certified firm or subcontractor acceptable to paneling manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's instructions.
- B. Scheduling: Do not deliver to site until project is enclosed, wet work is complete, and building temperature and humidity has stabilized to range acceptable to manufacturer.
- C. Acclimatization: Store panels in room where they will be installed for not less than 72 hours.

1.08 WARRANTY

- A. Provide manufacturer's 35-year limited warranty.

PART 2 - PRODUCTS

2.01 PANELS

A. Product:

1. Basis of Design: Concreate Wall Panels by Concreate LLC, www.Concreate.net, info@Concreate.net , +1 855 265 2116.

B. Description:

1. Size: 1200 x 600 x 4 mm (47-1/4 x 23-5/8 x 1/8 inch).
2. Composition: Portland cement concrete with recycled fiber reinforcement.
3. Color: [Natural Grey] [Dark Grey] [Mineral White] [To be selected from manufacturer's standard colors] [Custom].
4. Variations in color and appearance characteristic of natural concrete are acceptable.
5. Volatile Organic Compound (VOC) Emissions: Green Leaf certified, VOC free
6. Toxin Free: Product is formaldehyde and asbestos free

2.02 ACCESSORIES

A. Adhesive: Concreate Wall Panel Adhesive.

B. Repair Products: Concreate Concrete Floor Repair Powder and Concreate Floor Repair Oil.

C. Cleaning Products: Types recommended by panel manufacturer and as manufactured by Wood Care Denmark (WOCA), www.woodcareusa.com.

D. Trim: Aluminum edge trim by manufacturer.

PART 3 - EXECUTION

3.01 PREPARATION

A. Inspect substrates to which paneling will be installed. Do not begin installation until:

1. Work to be installed behind paneling is complete and approved.
2. Substrates are within manufacturer's tolerances for flatness and alignment.
3. Substrates are firm and cohesive.

B. Remove loose paint, oil, dust, and other materials that can interfere with adhesive bond.

3.02 INSTALLATION

A. Install in accordance with manufacturer's written instructions.

B. Pattern: Install panels as shown on Drawings.

3.03 REPAIR AND PROTECTION

A. Repair minor scratches and chips with repair materials. If damaged work cannot be repaired to satisfaction of Architect, removed damage work and replace with new materials.

B. Protect against damage

3.04 FINAL CLEANING

A. Clean paneling immediately prior to Substantial Completion following manufacturer's written instructions.

END OF SECTION

SECTION 09 84 00

ACOUSTICAL WALL PANELS

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 SCOPE OF WORK SUMMARY

A. Supply and install all Acoustical Wall Panels, as shown on Drawings and as specified herein, including all materials and labor for a timely, complete, and proper installation.

B. Section includes, but is not limited to:

1.03 STANDARDS AND REFERENCES

Comply with the Industry Standards and References as established by Manufacturer.

1.04 QUALITY ASSURANCE

Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

Provide in accordance with Section 01 33 00 Submittal Procedures.

1.07 DELIVERY, STORAGE, AND HANDLING

Comply with the requirements of Section 01 66 00 Product Storage and Handling Requirements.

1.08 PROJECT CONDITIONS

A. Comply with Manufacturer's Standard Requirements.

1.09 WARRANTY

Provide Manufacturer's Standard Warranty in accordance with Section 01 78 36 Warranties & Bonds.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Basis of Design Manufacturer: Acoustical Art Concepts; 391 Hickory Street, Mount Airy, NC 27030; Phone (336)786-6254; Web <https://acousticalartconcepts.com>; Contact josh@interlam-design.com

2.02 PRODUCT

A. Basis of Design Product: Akupanel 1x025s

1. Composition: Black PET Polyester Fiber, Black thru colored MDF and real wood veneer.
2. Panel Size: 24 inches x 96 inches x 13/16 inches
3. Finish: As indicated in the Drawings.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which work of this Section will be performed.
- B. Notify the Construction Manager and Architect in writing of any conditions detrimental to the proper and timely completion of the installation.
- C. Correct conditions detrimental to timely and proper complete of the Work.
- D. Do not proceed until unsatisfactory conditions are corrected.
- E. Beginning of installation means acceptance of conditions.

3.02 INSTALLATION

- A. Install panels on walls as recommended by the manufacturer in locations as indicated on the Drawings.

END OF SECTION

SECTION 09 84 13

SOUND ABSORBING WALL UNITS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Requirements apply to this Section.

1.02 SCOPE OF WORK SUMMARY

Supply and install Acoustic Wall Panels as shown on Drawings and as specified herein, including all materials and labor for a timely, complete and proper installation.

1.03 STANDARDS AND REFERENCES

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2009a.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- C. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2016.
- D. CAN/ULC-S102.2 – Standard Method of Test for Surface Burning Characteristics; 2018.

1.04 SUBMITTALS

- A. General: Submit manufacturer's documentation for each type of product under provisions of Section 01 30 30 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed data sheets for products specified.
- C. Shop Drawings: Fabrication and installation details, panel layout.
- D. Selection Samples: Manufacturer's color charts for applicable material, indicating full range of material, colors, and patterns available.
- E. Verification Samples: Fabricated samples of each type of product specified; 6" minimum length and width, showing construction, edge details.
- F. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.
- G. Maintenance Materials: Furnish maintenance information and recommendations for Owner's use.

1.05 QUALITY ASSURANCE

- A. Source Limitations: All similar products to be obtained from a single manufacturer through one source providing a comprehensive material and installation package.
- B. Installer Qualifications: Utilization of an installer with demonstrated experience and quality in projects of similar size and complexity.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation. Ensure all supplied hardware, material, and components are maintained until product is fully installed.
- B. Store units flat, in dry, well-ventilated space; do not stand on end.

- C. Protect edges from damage.
- D. Acclimatize product for minimum 24 hours at temperature and humidity approximately that of occupancy prior to installation.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install materials until spaces are enclosed from the exterior environment, wet work in spaces is complete and dry, and HVAC system is maintaining an ambient temperature at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Installer to verify field measurements and dimensions as indicated in Shop Drawing.
 - 1. Coordinate location of other product and trades with product layout.
- C. Ensure that Shop Drawing or Product Order Form signoffs and other required information are supplied in time to prevent interruption of construction process. Ensure that products of this section are supplied to affected trades in time to prevent interruptions.

1.08 WARRANTY

- A. Special Warranty: Refer to manufacturer's standard warranty for specific products, terms, and limitations.

PART 2 - PRODUCTS

2.01 MANUFACTURER

Basis of Design Manufacturer: Turf Design; Located at 41 Prairie Pkwy, Gilberts, IL 60136; Phone: 844.TURF.OMG (844.887.3664); Email: hello@turf.design; Web: www.turf.design

2.02 SOUND-ABSORBING/SOUND-DIFFUSING PANELS: AWP-2

- A. Basis of Design:
 - 1. Turf Design; Product: Hex Tile
- B. Material Minimum Performance Attributes:
 - 1. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 2. UL Tested ASTM E-84: Class A
 - 3. CAN/ULC-S102.2 Compliant
 - 4. Noise Reduction Coefficient (NRC):
 - a. Tested in accordance with ASTM C423 for Type A mounting, per ASTM E795.
 - i. Average NRC Hex Tile > 0.9
 - ii. Average NRC Hive Tile > 0.25
- C. Product Attributes:
 - 1. Tile Size: As indicated in Product Drawings and per Architects approval.
 - a. Hex Tile 13.5" x 11.69" x 2.25"D
 - b. Hive Tile Thickness: 9mm
 - 2. Edges: Exposed and folded felt, machined edge.
 - 3. Corners: Square, exposed and folded felt, machined edge.

4. Material: Polyester (PET) felt, 60% pre-consumer recycled
5. Color: As selected by Architect from manufacturer's full range.
6. Patterns: As selected by Architect from manufacturer's full range and outlined in Shop Drawings or Product Order Form.
7. Mounting Method:
 - a. Hex Tile: Installer applied construction adhesive.
 - b. Hive Tile: Installer applied construction adhesive to non-adhesive back tile.

2.03 SOUND-ABSORBING/SOUND-DIFFUSING PANELS: AWP-3

A. Basis of Design:

1. Turf Design; Product: Reed Wall Panel

B. Material Minimum Performance Attributes:

1. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
2. UL Tested ASTM E-84: Class A
3. CAN/ULC-S102.2 Compliant
4. Noise Reduction Coefficient (NRC):
 - a. Tested in accordance with ASTM C423 for Type A mounting, per ASTM E795.
 - b. Average NRC 2" pattern = 0.9

C. Product Attributes:

8. Tile Size:
 - a. As indicated in the Drawings.
 - b. 12" x 24" NOM Typical
9. Tile Depth: 2"D NOM
10. Edges: Exposed and folded felt, machined edge.
11. Corners: Square, exposed and folded felt, machined edge.
12. Material: Polyester (PET) felt, 60% pre-consumer recycled
13. Color: As selected by Architect from manufacturer's full range.
14. Patterns: As selected by Architect from manufacturer's full range and outlined in Product Order Form / Submittal Drawings.
15. Mounting Method:
 - a. Integrated z-clip mounting bracket to included 2" wall mount z-clips.

2.04 FABRICATION

- A. Hex Tile: CNC fabricate tiles to sizes, configurations and patterns on 9mm material with open core. Folded construction.
- B. Hive Tile: CNC fabricate tiles to sizes, configurations and patterns on 9mm material.
- C. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and square-ness from corner to corner.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install acoustical units in locations indicated, following manufacturer's installation instructions and in accordance with local jurisdiction authorities.
- B. Wall surface to be smooth, cleaned, and dry prior to installation of product.
- C. Mounting
 - 1. Hex & Hive Tiles Only: Directly adhere to tile to wall surface with installer applied construction adhesive.
 - 2. Reed Panels Only: Install included z-clip mounting brackets to wall, aligning with factory installed z-clip rail on back of panel. Fasteners/anchors by others.
- D. Align tiles accurately, with edges plumb and level.
- E. For Hex & Hive Tiles Only: Do not trim or cut Folded Tile. Use coordinating Turf flat tile product around any cutout areas and trim in field.
- F. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:
 - 1. Plumb and level.
 - 2. Flatness.
 - 3. Width of joints.

3.03 CLEANING

- A. Clean felt facing upon completion of installation from dust and other foreign materials, following manufacturer's instructions.
- B. Vacuum occasionally to remove any particulate matter and air-borne debris or dust. Compressed air can be used to dust the material in difficult to reach areas or for large assemblies.

3.04 PROTECTION

- A. Provide protection of installed acoustical panels until completion of the work.
- B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION

SECTION 09 90 00

PAINTING

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 SCOPE OF WORK SUMMARY

- A. Supply and install all Painting, as shown on Drawings and as specified herein, including all materials and labor for a timely, complete, and proper installation.
- B. Section Includes: Painting and finishing of all interior and exterior items and surfaces, unless otherwise indicated or listed under exclusions below:
 - 1. Paint all exposed surfaces, except as otherwise indicated, whether or not colors are designated.
 - 2. Include field painting of exposed exterior and interior structural steel, plumbing, mechanical and electrical work, except as indicated below.
 - 3. Paint exterior plaster where indicated on Drawings.
- C. Work Included:

The intent and requirements of this section is that all work, items and surfaces which are normally painted and finished in a building of this type and quality, shall be so included in this contract, whether or not said work, item or surface is specifically called out and included in the schedules and notes on the drawings, or is, or is not, specifically mentioned in these specifications.
- D. The following general categories of work and items that are included under other sections, shall not be a part of this section:
 - 1. Shop prime painting of structural and miscellaneous iron or steel.
 - 2. Shop prime painting of hollow metal work.
 - 3. Shop finished work and items.
 - 4. Any drywall or plaster permanently concealed from view.
 - 5. Any factory finished equipment and other materials with a complete factory applied finish.
 - 6. Finish hardware except where primed for paint finish.
 - 7. Any glass, plastics, floor tiles and sheet vinyl coved or vinyl top set bases.
 - 8. Plumbing fixtures: Toilet room accessories.
 - 9. Lighting fixtures except as noted on drawings or specified.
 - 10. Any acoustical surfaces; unless otherwise specified.
- E. The Room Finish Schedules indicated on the drawings, indicates the location of interior room surfaces to be painted or finished. The schedule indications are general and do not necessarily define the detail requirements. Include all detailed refinements and further instructions as may be given for the required complete finishing of all spaces and rooms.

1.03 STANDARDS AND REFERENCES

- A. Regulatory Requirements: Comply with applicable codes and regulations of governmental agencies having jurisdiction including those having jurisdiction over airborne emissions and industrial waste disposal. Where those requirements conflict with this Specification, comply with the more stringent provisions.

- B. Regulatory changes may affect the formulation, availability, or use of specified coatings. Confirm availability of coatings to be used prior to job going out to bid and before start of painting project.
- C. Comply with the current applicable regulations of the California Air Resources Board (CARB) and the South Coast Air Quality Management District (SCAQMD). Field Sample: When and as directed by the Architect, apply one complete coating system for each color, gloss and texture required. When approved, the sample panel areas will be deemed incorporated into the Work and will serve as the standards by which the subsequent Work of this Section will be judged.

1.04 QUALITY ASSURANCE

Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

- A. Provide in accordance with Section 01 33 00 Submittal Procedures.
- B. Materials List: Submit complete lists of materials proposed for use, giving the manufacturer's name, catalog number, and catalog cut for each item when applicable. When required, provide a list of paint and coating materials proposed for use, which equates such materials with the design-basis products specified.
- C. Samples: Submit, on 8-1/2 inch by 11 inch hardboard, samples of each color, gloss, texture and material selected by the Architect from standard colors available for the coatings required. For natural and stained finishes, provide sample on each type and quality of wood used on the project.
- D. Manufacturer's Instructions: Submit the manufacturer's current recommended methods of installation, including relevant limitations, safety and environmental cautions, application rates, and composition analysis.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of Section 01 66 00 Product Storage and Handling Requirements.
- B. Storage and Protection: Use all means necessary to protect the materials of this Section before, during, and after installation.
- C. Deliver materials to job site in new, original, and unopened containers bearing manufacturer's name and trade name. Store where directed in accordance with manufacturer's instructions.

1.08 PROJECT CONDITIONS

- A. Comply with the requirements of Section 01 50 00 Construction Facilities.
- B. Do not apply exterior materials during fog, rain or mist, or when inclement weather is expected within the dry time specified by the manufacturer. No exterior or interior painting shall be done until the surfaces are thoroughly dry and cured. Do not apply paint when temperature is below 50° F. Avoid painting surfaces when exposed to direct sunlight.

1.09 OPERATION AND MAINTENANCE DATA

- A. Provide in accordance with Section 01 77 00 Project Closeout.
- B. Coating Maintenance Manual: Provide a S-W Custodian or similar coating maintenance manual including area summary with finish schedule, area detail designating location 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.

1.10 EXTRA MATERIALS

- A. Provide in accordance with Section 01 77 00 Project Closeout.
- B. Provide 5% with a minimum of one gallon of each color and product used.

1.11 WARRANTY

Provide Manufacturer's Standard Warranty in accordance with Section 01 78 36 Warranties.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Sherwin-Williams. Architectural representative: Rocky Berlanga; Phone (657)269-0922 or Email rocky.m.berlanga@sherwin.com.
- B. Acceptable Manufacturers: Dunn Edwards, Vista Paint or Architect approved equal.

2.02 MATERIALS

- A. Paints: Provide Ready-Mixed, except field catalyzed coatings. Pigments shall be fully ground maintaining soft paste consistency, capable of being readily and uniformly dispersed to complete homogeneous mixture. Paints shall have good flowing and brushing properties and be capable of drying or curing free of streaks and sags.
- B. Accessory Materials: Linseed oil, shellac, solvents, and other materials not specified but required to achieve required finishes shall be of high quality and approved by manufacturer.
- C. Colors shall be selected from color chip samples provided by manufacturer of paint system approved for use. Match approved samples for color, texture and coverage.

2.03 MIXES

Mix, prepare, and store painting and finishing materials in accordance with manufacturer's directions.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which work of this Section will be performed.
- B. Examine surfaces to be painted before beginning painting work. Work of other trades that has been left or installed in a condition not suitable to receive paint, stain, other specified finish shall be repaired or corrected by the applicable trade before painting. Painting of defective or unsuitable surface implies acceptance of the surfaces.
- C. Do not proceed with surface preparation or coating application until conditions are suitable. Special attention should be made to all smooth and especially Level 5 Drywall Finish areas. In those instances, a test patch to ensure proper surface adhesion should be undertaken.
- D. Beware of a condition known as "critical lighting". This condition causes shadows that accentuate even the slightest surface variations. A pigmented sealer will provide tooth for succeeding decorative coating, but "does not" equalize smoothness or surface texture. Any corrective action to gypsum board/drywall must be done by the drywall contractor prior to decorating.
- E. Notify the Construction Manager and Architect in writing of any conditions detrimental to the proper and timely completion of the installation.
- F. Correct conditions detrimental to timely and proper completion of the Work.
- G. Do not proceed until unsatisfactory conditions are corrected.
- H. Beginning of installation means acceptance of conditions.

3.02 PROTECTION

- A. Protect previously installed work and materials, which may be affected by Work of this Section.
 - 1. Protect prefinished surfaces, lawns, shrubbery and adjacent surfaces against paint and damage.

2. Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or splatter from fouling surfaces not being painted.
 3. Protect surfaces, equipment, and fixtures from damage resulting from use of fixed, movable and hanging scaffolding, planking, and staging.
- B. Provide WET PAINT signs, barricades, and other devices required to protect newly finished surfaces. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

3.03 PREPARATION

- A. Perform preparation and cleaning procedures in strict accordance with coating manufacturer's instructions for each substrate condition.
- B. Concrete and masonry surfaces shall be dry, clean, and free of dirt, efflorescence, encrustation, and other foreign matter. Glazed surfaces on concrete shall be roughened or etched to uniform texture.
- C. Ferrous metal shall be cleaned per SSPC-SP1. All welds, loosely adhered rust, and debris must be power tool cleaned per SSPC-SP3. Prime within 3 hours after preparation.
- D. Clean per SSPC-SP1 to remove greases and oils. Apply a test area, priming as required. Allow the coating to dry at least one week before testing. If adhesion is poor, power tool clean per SSPC-SP3 to remove these treatments.
- E. Remove dust, grit and foreign matter from wood surfaces. Sand surfaces and dust clean. Spot coat knots, pitch streaks, and sappy section with pigmented stain sealer when surfaces are to be painted. Fill nail holes, cracks and other defects after priming and spot prime repairs when fully cured.
- F. Remove hardware and accessories, machined surfaces, plates, lighting fixtures and similar items in place and not-to-be-finish painted, or provide surface-applied protection. Reinstall removed items upon completion of work in each area.
- G. Existing surfaces to be recoated shall be thoroughly cleaned and de-glossed by sanding or other means prior to painting. Patched and bare areas shall be spot primed with same primer as specified for new work.
- H. Thoroughly backpaint all surfaces of exterior and interior finish lumber and millwork, including doors and window frames, trim, cabinetwork, etc., which will be concealed after installation. Backpaint items to be painted or enameled with the priming coat. Use a clear sealer for backpriming where transparent finish is required.
- I. Bar and covered pipes, ducts, hangers, exposed steel and ironwork, and primed metal surfaces of equipment installed under mechanical and electrical work shall be cleaned prior to priming.
- J. Preparation of other surfaces shall be performed following specific recommendations of the coatings manufacturer.
- K. Bond breakers and curing agents must be removed and the surface cleaned before primers, sealers or finish paints can be applied.
- L. All drywall surfaces must be completely dry and dust free before painting. Skim coated drywall must be sealed with an alkyd based sealer or a waterborne sealer recommended by the paint manufacturer for this surface. Use the appropriate light or medium tack masking tape.
- M. Do not apply initial coating until moisture content of surface is within limitations recommended by the paint manufacturer.
- N. Do not paint over Underwriters's labels, fusible links or sprinkler heads.

3.04 APPLICATION

- A. Apply painting and finishing materials in accordance with the manufacturer's submittals, as approved. Use applicators and techniques best suited for the material and surfaces to which applied.

1. The number of coats specified is the minimum that shall be applied. Apply additional coats when undercoats, stains or other conditions show through final paint coat, until paint film is of uniform finish, color and appearance.
 2. All undercoats shall be tinted slightly to approximate the color of the finish coat.
- B. Apply each material at not less than the manufacturer's recommended spreading rate:
Provide a total dry film thickness of not less than 1.2 mils for each required coat.
- C. Apply prime coat to surface, which is required to be painted or finished.
- D. Finish exterior doors on tops, bottoms, and edges same as exterior faces, after fitting.
- E. Sand lightly and dust clean between succeeding coats.

3.05 CLEANING, TOUCH-UP AND REFINISHING

- A. Carefully remove all spattering, spots and blemishes caused by work under this section from surfaces throughout the project.
- B. Upon completion of painting work remove all rubbish, paint cans, and accumulated materials resulting from work in each space or room. All areas shall be left in a clean, orderly condition.
- C. Runs, sags, misses, holidays, stains and other defects in the painted surfaces, including inadequate coverage and mil thickness shall be satisfactorily touched up, or refinished, or repainted as necessary.

3.06 FINISH SCHEDULE

- A. Apply the following finishes to the surfaces specified and/or as on the finish schedule on the Drawings. Apply all materials in accordance with manufacturer's instructions on properly prepared surfaces and foundation coats. All intermediate undercoats must be tinted to approximate the final color.

Architect will issue a color schedule prior to start of painting to designate the various colors and locations required for the work.

- B. Exterior Systems:

1. Stucco & Plaster

- a. Flat – 100% Acrylic

First Coat	Loxon Primer LX2W50
Second Coat	A-100 Exterior Latex Flat A6 Series
Third Coat	A-100 Exterior Latex Flat A6 Series

2. Concrete Block

- a. Flat – 100% Acrylic

First Coat	PrepRite Block Filler B25W25
Second Coat	A-100 Exterior Latex Flat A6 Series
Third Coat	A-100 Exterior Latex Flat A6 Series

5. Ferrous Metal

- b. Semi-Gloss – Acrylic

First Coat	ProCryl Universal Acrylic Metal Primer B66-310
Second Coat	Solo Acrylic Latex Semigloss A76 Series
Third Coat	Solo Acrylic Latex Semigloss A76 Series
- c. Gloss – Acrylic

First Coat	ProCryl Universal Acrylic Metal Primer B66-310
Second Coat	Solo Acrylic Latex Gloss A77 Series
Third Coat	Solo Acrylic Latex Gloss A77 Series

- d. Gloss – Rust Preventative Acrylic
 - First Coat ProCryl Universal Acrylic Metal Primer B66-310
 - Second Coat ProIndustrial Acrylic Gloss B66-600 Series
 - Third Coat ProIndustrial Acrylic Gloss B66-600 Series
- e. Gloss, Industrial High Performance – Inorganic Zinc/Epoxy/Acrylic
 - First Coat ZincClad III HS-100 B69 Series
 - Second Coat Macropoxy 646-100 B58 Series
 - Third Coat ProIndustrial Acrylic Gloss B66-600 Series (Coat to Cover)
- f. Low Sheen, Industrial High Performance – Epoxy Primer/Epoxy/Acrylic
(VOC compliant in SCAQMD)
 - First Coat Macropoxy 646-100 B58 Series
 - Second Coat Macropoxy 646-100 B58 Series
 - Third Coat ProIndustrial Acrylic Eg-shel B66-660 Series (Coat to cover)
- g. High Gloss, Industrial High Performance – Inorganic Zinc/Epoxy/Urethane
(VOC compliant in SCAQMD)
 - First Coat ZincClad III HS-100 B69 Series
 - Second Coat Macropoxy 646-100 B58 Series
 - Third Coat Acrolon 100 WB Polyurethane B65 Series (Coat to Cover)
- h. High Gloss, Industrial High Performance – Epoxy Primer/Epoxy/Urethane
(VOC compliant in SCAQMD)
 - First Coat Macropoxy 646-100 B58 Series
 - Second Coat Acrolon 100 WB Polyurethane B65 Series
 - Third Coat Acrolon 100 WB Polyurethane B65 Series

6. Galvanized Metal

- a. Semi-Gloss – Acrylic
 - Pretreatment GLL Clean n Etch
 - First Coat ProCryl Universal Acrylic Metal Primer B66-310
 - Second Coat Solo Acrylic Latex Semigloss A76 Series
 - Third Coat Solo Acrylic Latex Semigloss A76 Series
- b. Gloss – Acrylic
 - Pretreatment GLL Clean n Etch
 - First Coat ProCryl Universal Acrylic Metal Primer B66-310
 - Second Coat Solo Acrylic Latex Gloss A77 Series
 - Third Coat Solo Acrylic Latex Gloss A77 Series
- c. Gloss – Rust Preventative Acrylic
 - First Coat ProCryl Universal Acrylic Metal Primer B66-310
 - Second Coat ProIndustrial Acrylic Gloss B66-600 Series
 - Third Coat ProIndustrial Acrylic Gloss B66-600 Series
- d. Low Sheen, Industrial High Performance – Epoxy Primer/Acrylic
(VOC compliant in SCAQMD)
 - First Coat Macropoxy 646-100 B58 Series
 - Second Coat ProIndustrial Acrylic Eg-shel B66-660
 - Third Coat ProIndustrial Acrylic Eg-shel B66-660
- e. High Gloss, Industrial High Performance – Epoxy Primer/Urethane
 - First Coat Macropoxy 646-100 B58 Series
 - Second Coat Acrolon 100 WB Polyurethane B65 Series
 - Third Coat Acrolon 100 WB Polyurethane B65 Series

B. Interior Systems:

1. Gypsum Board

- a. Flat – Acrylic
 - First Coat PVA Primer B28W8000
 - Second Coat ProMar 200 Zero VOC Flat B30-2600
 - Third Coat ProMar 200 Zero VOC Flat B30-2600
- b. Low Sheen – Acrylic
 - First Coat PVA Primer B28W8000
 - Second Coat ProMar 200 Zero VOC Low Sheen B24-2600
 - Third Coat ProMar 200 Zero VOC Low Sheen B24-2600
- d. Semi-Gloss - Acrylic
 - First Coat PVA Primer B28W8000
 - Second Coat ProMar 200 Zero VOC Semigloss B31-2600
 - Third Coat ProMar 200 Zero VOC Semigloss B31-2600
- e. Gloss – Acrylic
 - First Coat PVA Primer B28W8000
 - Second Coat ProMar 200 Zero VOC Gloss B21-12650
 - Third Coat ProMar 200 Zero VOC Gloss B21-12650
- f. Gloss– Industrial High Performance – Waterborne Epoxy
 - First Coat ProMar 200 Zero VOC Primer B28W2600
 - Second Coat WB Catalyzed Epoxy Gloss B73 Series
 - Third Coat WB Catalyzed Epoxy Gloss B73 Series
- g. High Gloss – Industrial High Performance – Waterborne Epoxy/Urethane
 - First Coat Macropoxy 646-100 B58 Series
 - Second Coat Acrolon 100 WB Polyurethane B65 Series
 - Third Coat Acrolon 100 WB Polyurethane B65 Series

2. Concrete & Plaster:

- a. Flat – Acrylic Copolymer
 - First Coat Loxon Primer LX2W50
 - Second Coat ProMar 200 Zero VOC Flat B30-2600
 - Third Coat ProMar 200 Zero VOC Flat B30-2600
- b. Low Sheen – Acrylic Copolymer
 - First Coat Loxon Primer LX2W50
 - Second Coat ProMar 200 Zero VOC Low Sheen B24-2600
 - Third Coat ProMar 200 Zero VOC Low Sheen B24-2600
- c. Semi-Gloss –Acrylic Copolymer
 - First Coat Loxon Primer LX2W50
 - Second Coat ProMar 200 Zero VOC Semigloss B31-2600
 - Third Coat ProMar 200 Zero VOC Semigloss B31-2600
- d. Gloss – 100% Acrylic
 - First Coat Loxon Primer LX2W50
 - Second Coat ProMar 200 Zero VOC Gloss B21-12650
 - Third Coat ProMar 200 Zero VOC Gloss B21-12650
- e. Gloss – Industrial High Performance - Waterborne Epoxy
 - First Coat Loxon Primer LX2W50

Second Coat	WB Catalyzed Epoxy Gloss B73 Series
Third Coat	WB Catalyzed Epoxy Gloss B73 Series
- f. High Gloss- Industrial High Performance - Epoxy/Urethane
- | | |
|-------------|--|
| First Coat | Macropoxy 646-100 B58 Series |
| Second Coat | Acrolon 100 WB Polyurethane B65 Series |
| Third Coat | Acrolon 100 WB Polyurethane B65 Series |
4. Concrete Block
- a. Flat – Acrylic Copolymer
- | | |
|-------------|-----------------------------------|
| First Coat | PrepRite Block Filler B25W25 |
| Second Coat | ProMar 200 Zero VOC Flat B30-2600 |
| Third Coat | ProMar 200 Zero VOC Flat B30-2600 |
- b. Low Sheen – Acrylic Copolymer
- | | |
|-------------|--|
| First Coat | PrepRite Block Filler B25W25 |
| Second Coat | ProMar 200 Zero VOC Low Sheen B24-2600 |
| Third Coat | ProMar 200 Zero VOC Low Sheen B24-2600 |
- c. Semi-Gloss –Acrylic Copolymer
- | | |
|-------------|--|
| First Coat | PrepRite Block Filler B25W25 |
| Second Coat | ProMar 200 Zero VOC Semigloss B31-2600 |
| Third Coat | ProMar 200 Zero VOC Semigloss B31-2600 |
- d. Gloss – 100% Acrylic
- | | |
|-------------|-------------------------------------|
| First Coat | PrepRite Block Filler B25W25 |
| Second Coat | ProMar 200 Zero VOC Gloss B21-12650 |
| Third Coat | ProMar 200 Zero VOC Gloss B21-12650 |
- e. Gloss – Industrial High Performance - Waterborne Epoxy
- | | |
|-------------|-------------------------------------|
| First Coat | PrepRite Block Filler B25W25 |
| Second Coat | WB Catalyzed Epoxy Gloss B73 Series |
| Third Coat | WB Catalyzed Epoxy Gloss B73 Series |
- f. High Gloss- Industrial High Performance – Acrylic/Urethane
- | | |
|-------------|--|
| First Coat | Heavy Duty Block Filler B42W46 |
| Second Coat | Macropoxy 646-100 B58 Series |
| Third Coat | Acrolon 100 WB Polyurethane B65 Series |
5. Ferrous Metal
- a. Flat – Acrylic Copolymer
- | | |
|-------------|--|
| First Coat | ProCryl Universal Acrylic Metal Primer B66-310 |
| Second Coat | ProMar 200 Zero VOC Flat B30-2600 |
| Third Coat | ProMar 200 Zero VOC Flat B30-2600 |
- b. Low Sheen –Acrylic Copolymer
- | | |
|-------------|--|
| First Coat | ProCryl Universal Acrylic Metal Primer B66-310 |
| Second Coat | ProMar 200 Zero VOC Low Sheen B24-2600 |
| Third Coat | ProMar 200 Zero VOC Low Sheen B24-2600 |
- c. Semi-Gloss – Acrylic Primer/ Acrylic Copolymer
- | | |
|-------------|--|
| First Coat | ProCryl Universal Acrylic Metal Primer B66-310 |
| Second Coat | ProMar 200 Zero VOC Semigloss B31-2600 |
| Third Coat | ProMar 200 Zero VOC Semigloss B31-2600 |
- d. Semi-Gloss –Rust Preventative Acrylic
- | | |
|-------------|--|
| First Coat | ProCryl Universal Acrylic Metal Primer B66-310 |
| Second Coat | ProIndustrial Acrylic SemiGloss |
| Third Coat | ProIndustrial Acrylic SemiGloss |

- e. Gloss – Acrylic Primer /100% Acrylic
 - First Coat ProCryl Universal Acrylic Metal Primer B66-310
 - Second Coat Solo Acrylic Latex Gloss A77 Series
 - Third Coat Solo Acrylic Latex Gloss A77 Series
- f. Gloss –Rust Preventative Acrylic
 - First Coat ProCryl Universal Acrylic Metal Primer B66-310
 - Second Coat ProIndustrial Acrylic Gloss
 - Third Coat ProIndustrial Acrylic Gloss
- g. Gloss – Industrial High Performance - Waterborne Epoxy
 - First Coat ProCryl Universal Acrylic Metal Primer B66-310
 - Second Coat WB Catalyzed Epoxy Gloss B73 Series
 - Third Coat WB Catalyzed Epoxy Gloss B73 Series
- h. High Gloss – Industrial High Performance - Epoxy/Urethane
 - First Coat Macropoxy 646-100 B58 Series
 - Second Coat Acrolon 100 WB Polyurethane B65 Series
 - Third Coat Acrolon 100 WB Polyurethane B65 Series

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Requirements apply to this Section.

1.02 SCOPE OF WORK SUMMARY

Supply and install all exterior and interior signage, as shown on Drawings and as specified herein, including all materials and labor for a timely, complete and proper installation.

1.03 STANDARDS AND REFERENCES

Comply with the Industry Standards and References as established by Manufacturer.

1.04 QUALITY ASSURANCE

Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 Submittal Procedures.

B. Provide:

1. Shop Drawings: Provide shop drawings for review and approval prior to commencement of fabrication.
2. Samples: Provide to illustrate full size sample sign, of type, style and color specified including method of attachment.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with the requirements of Section 01 66 00 Product Storage and Handling Requirements.

B. Package signs, labeled in name groups.

C. Store adhesive tape at ambient room temperatures.

1.08 PROJECT CONDITIONS

A. Comply with the requirements of Section 01 50 00 Construction Facilities.

B. Do not install signs when ambient temperature is below 70 degrees F. Maintain this minimum during and after installation of signs.

1.9 WARRANTY

Provide Manufacturer's Standard Warranty in accordance with Section 01 78 36 Warranties.

PART 2 – PRODUCTS

2.01 DEDICATION PLAQUE

Refer to Drawings for location, size, text, and material details.

2.02 ACCESSORIES

- A. Mounting Hardware: Chrome screws; base sleeve and studs per manufacturer's recommendations.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine the areas and conditions under which work of this Section will be performed.
- B. Verify adequate support for Building Signs. Coordinate footings with other trades.
- C. Correct conditions detrimental to timely and proper completion of the Work.
- D. Do not proceed until unsatisfactory conditions are corrected.
- E. Beginning of installation means acceptance of conditions.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install signs after doors and surfaces are finished, in locations indicated.
 - 1. Furnish and install all anchorage devices required to install the item and its appurtenances complete. Provide anchorage in ample time when required to be built in by other trades.
- C. Anchor all components firmly into position for long life under hard use.
- D. Clean and polish.

END OF SECTION

SECTION 10 22 13

SECURITY MESH

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Conditions apply to this Section.

1.02 SCOPE OF WORK

- A. Supply and install steel expanded mesh panels as a penetration barrier behind wall board using the manufacturers' recommended method of installation.
- B. System Description: As manufactured by AMICO Security, Security Mesh™ shall be made from a sheet of steel that is simultaneously slit and stretched into a rigid and open continuous sheet that cannot unravel. The finished shape of the mesh openings shall be a flattened diamond. Conventional expanded metal not manufactured specifically for security purposes is NOT acceptable for this use. Security Mesh™ shall be attached to framing members by using AMICO Secura Clip™ fasteners following the manufacturers recommended spacing.

1.03 STANDARDS AND REFERENCES

All components and parts in this specification shall meet or exceed current standards and specifications as designated by the American Society for Testing and Materials and shall be certified Security Mesh™ per ASTM F1267, Type 2, Class 1 mill finish. Underwriters Laboratories Fire Rated Assemblies (per U/L subject File #1857) will not be jeopardized by using AMICO's Security Mesh™ in the fire rated assembly.

1.04 QUALITY ASSURANCE

Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTAL

- A. Provide in accordance with Section 01 33 23 Submittals.
- B. The manufacturers' submittal information shall include brochures, details and specifications and samples.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of Section 01 60 00 Materials and Equipment.
- B. Materials shall be stored in a clean dry location with proper ventilation to avoid damage from moisture. Materials shall be protected against damage from weather, vandalism, and theft. In the event of freight damage, note freight bill and contact manufacturer immediately.

1.08 WARRANTY

Provide manufacturer's standard warranty in accordance with Section 01 78 00 Warranties.

PART 2 - MATERIALS

2.01 MANUFACTURER

Basis of Design Manufacturer: Amico Security, 3245 Fayette Avenue, Birmingham, AL 35208, Email: securitymesh@amicosecurity.com, Web: www.amicosecurity.com, Telephone Direct: 205-783-6219, Toll Free: 855-552-6426

2.02 MATERIALS

A. Basis of Design Model: Amico Security Mesh – ASM .75 –16F Minimum Security.

1. The Security Mesh™ used shall conform to the following specification: Carbon steel – meet or exceed ASTM A-1011.

B. Physical Properties

1. Width of panel – 4ft (1,219mm) Also produced in 5ft (1,524mm) and 6ft (1,829mm) widths
2. Length of panel – 8ft (2,438mm) Also produced in 10ft (3,048mm) and 12ft (3,658mm) lengths
3. Mesh diamond width – 0.923in (23.44mm) x 2.100in (53.34mm) long bond to bond with 13 diamonds per 12in (304.8mm) of width
4. Mesh size opening – width 0.750in (19.05mm) x 1.750in (44.45mm) long allowing 76% open area
5. Mesh strand width – 0.111in (2.82mm)
6. Mesh strand thickness – 0.048in (1.22mm)
7. Weight – 0.47 lbs (2.29 kg/m²)
8. Tolerances: SWD = -0 + 0.25in (6.4mm) per 12in (304.8mm) of dimension LWD = -0 + 0.25in (6.4mm) per 12in (304.8mm) of dimension

C. Fasteners: Security Mesh™ shall be attached to framing members using AMICO Secura Clip™ fasteners and the appropriate threaded fasteners. Welding is an acceptable means of attachment. Flat bugle head self-tapping screws long enough to penetrate steel framing by a minimum 3/8in (9.5mm). For wood framing applications use 1-5/8-in (41mm) fine thread drywall screw allowing the fastener to penetrate the framing member at least 1-1/2in (38.1mm). Install Secura Clip™ fasteners, at a minimum, on 12in (304.8mm) centers per framing member. Secura Clip™ fasteners are the manufacturer's preferred method of securing mesh panels to framing.

D. Finish: Security Mesh is supplied "mill finish" HR P&O. No sealers or galvanizing is required for typical applications. In some very unique situations stainless steel Security Mesh is supplied. For information concerning applications where stainless steel may be advantageous, please call 205-783-6219 or 855-552-6426.

PART 3 EXECUTION

3.01 INSTALLATION

Framing members should be no less than 20GA. Security Mesh panels may be installed with diamonds running in either direction. It is preferred to have mesh joints either join staggered (Detail A) or butt together (Detail B). It is also acceptable to overlap mesh joints with owner's prior written approval. Panels shall join on framing members. If panels join in between framing members, in any direction, adjoining panels shall be tied with 18GA tie wire at the same frequency as clips or welding.

END OF SECTION

SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Requirements apply to this Section.

1.02 SCOPE OF WORK SUMMARY

Supply and install all Fire Extinguishers and Cabinets, as shown on Drawings and as specified herein, including all materials and labor for a timely, complete, and proper installation

1.03 STANDARDS AND REFERENCES

Comply with the Industry Standards and References as established by Manufacturer

1.04 QUALITY ASSURANCE

- A. Conform to NFPA 10 requirements for extinguishers.
- B. Provide fire extinguishers, cabinets, and accessories by single manufacturer.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

- A. Provide in accordance with Section 01 33 23 Submittals.
- B. Submit the following:
 - 1. Physical dimensions, operational features, color and finish, wall-mounting brackets with mounted measurements, anchorage details, rough-in measurements, location, and details.
 - 2. Manufacturer's installation instructions.
 - 3. Manufacturer's operation and maintenance data.
 - 4. Include test, refill or recharge schedules, procedure, and re-certification requirements.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Comply with the requirements of Section 01 60 00 Materials and Equipment.
- B. Do not install extinguishers when ambient temperatures may cause freezing.

1.08 PROJECT CONDITIONS

- A. Comply with the requirements of Section 01 50 00 Construction Facilities.
- B. Comply with Manufacturer's Standard Requirements.

1.09 OPERATION AND MAINTENANCE DATA

Provide in accordance with Section 01 78 39 Contract Closeout.

1.10 WARRANTY

Provide Manufacturer's Standard Warranty in accordance with Section 01 78 00 Warranties.

PART 2 – PRODUCTS

2.01 MANUFACTURER

Basis of Design: Larsen's Manufacturing Company, 7421 Commerce Lane, N.E. Minneapolis, MN. 55432.
Website: www.larsensmfg.com. Phone: 1-800-527-7367.

2.02 EXTINGUISHERS

Multi-Purpose Chemical Type: Larsen's Steel tank, Model MP 5, with pressure gage, and UL Rating 2A-10B:C or approved equal.

2.03 CABINETS

Typical Extinguisher Cabinet:

- A. Provide Larsen's 2409-5R Vertical Duo Door Panel cabinet.
- B. Primer finish.

2.04 ACCESSORIES

- A. Mounting Hardware: Appropriate to cabinet - see manufacturer's installation instructions.
- B. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

2.05 FABRICATION

- A. Form body of cabinet with tight inside corners and seams.
- B. Pre-drill holes for anchorage.
- C. Form perimeter trim and door stiles by welding, filling, and grinding smooth.
- D. Hinge doors for 180 degree opening.
- E. Glaze doors with resilient channel gasket glazing.

2.06 FINISHES

- A. Extinguisher: Red enamel.
- B. Cabinet Trim and Door: Primed to be painted to match adjacent surface.
- C. Cabinet Interior: Enamel white.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions under which work of this Section will be performed.
- B. Verify that rough openings for cabinet are correctly sized and located.
- C. Correct conditions detrimental to timely and proper completion of the Work.
- D. Do not proceed until unsatisfactory conditions are corrected.
- E. Beginning of installation means acceptance of conditions.

3.02 INSTALLATION

- A. Install cabinets plumb and level in wall openings so that there is 54 inches from finished floor to door handle.
- B. Secure rigidly in place in accordance with manufacturer's instructions.

END OF SECTION

SECTION 11 31 13

APPLIANCES

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

Division 0, Contract Requirements and Division 1, General Requirements apply to this Section.

1.02 SCOPE OF WORK SUMMARY

Supply and install all Appliances, as shown on Drawings and as specified herein, including all materials and labor for a timely, complete, and proper installation.

1.03 STANDARDS AND REFERENCES

- A. ANSI A117-1 – Guidelines for Accessible and Useable Buildings and Facilities.
- B. EPA – Energy Star Appliances.
- C. Public Law 101-336 – Americans with Disabilities Act.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with referenced standards and the Americans with Disabilities Act as applicable for fixtures for the disabled.
- B. Energy Rating: Provide appliances with the EPA Energy Star label where applicable.
- C. Coordinate rough-in requirements with adjacent construction. Coordinate components and fittings to ensure compatible parts are installed.

1.05 SUBSTITUTIONS

Substitutions will be considered per Section 01 25 00 Substitution Procedures.

1.06 SUBMITTALS

- A. Provide in accordance with Section 01 33 23 Submittals.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Model number and selected options for each appliance.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.
 - 5. List of maintenance parts.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the requirements of Section 01 60 00 Materials and Equipment.
- B. Store products in manufacturer's unopened packaging until ready for installation.

1.08 PROJECT CONDITIONS

- A. Comply with the requirements of Section 01 50 00 Construction Facilities.
- B. Comply with Manufacturer's Standard Requirements.
- C. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.09 OPERATION AND MAINTENANCE DATA

Provide in accordance with Section 01 78 39 Contract Closeout.

1.10 WARRANTY

Provide Manufacturer's Standard Warranty in accordance with Section 01 78 00 Warranties.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Basis of Design Manufacturer: ULINE, 8900 North 55th Street, Milwaukee, Wisconsin, 53223.
Phone: (414) 354-0300. Website: www.uline.com

B. Or Owner approved equal.

2.02 PRODUCTS

A. As indicated in the Drawings.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions under which work of this Section will be performed.
- B. Do not begin installation until substrates have been properly prepared. Coordinate rough-in with appliance sized and utility requirements.
- C. Correct conditions detrimental to timely and proper completion of the Work.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Do not proceed until unsatisfactory conditions are corrected.
- F. Beginning of installation means acceptance of conditions.

3.02 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.

3.03 INSTALLATION

Assemble appliances and trim and install in accordance with manufacturer's instructions and the following:

- 1. Securely mount to substrate.
- 2. Install appliances plumb and level and in proper relationship to adjacent construction.
- 3. Connect appliances to building utility, supply and waste systems as applicable.
- 4. Test for proper orientation and drainage. Adjust until proper operation is achieved.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 23 00 10

BASIC MECHANICAL REQUIREMENTS

PART 1. GENERAL

1.01 SECTION INCLUDES

- A. Basic Mechanical Requirements specifically applicable to Division 23 Sections, in addition to Division 01 - General Requirements.

1.02 DESCRIPTION

- A. Furnish materials and perform labor required to execute this work as indicated on the drawings, as specified and as required to complete the work of this section, except as otherwise herein specifically excluded.

1.03 WORK INCLUDED

- A. The complete Heating, Ventilating and Air Conditioning (HVAC) systems, including but not limited to these major items.
 - 1. Coordinate work of this Section with related trades.
 - 2. Verify applicable dimensions and locations of existing utilities, fans, and thermostats at the jobsite.
 - 3. Duct systems; supply and return complete with manual dampers.
 - 4. Diffusers and registers.
 - 5. Furnishing and installation of miscellaneous hangers, supports, sleeves, inserts, anchors and other auxiliary equipment for systems under this Division.
 - 6. Duct lining and insulation.
 - 7. Piping, valves and insulation.
 - 8. Shop drawings.
 - 9. Equipment identification.
 - 10. Equipment and systems adjustments and balancing.
 - 11. Air and water systems testing, adjusting and balancing.
 - 12. Written operating and maintenance instructions.
 - 13. Record drawings.
 - 14. Guarantee

1.04 WORK SPECIFIED ELSEWHERE

- A. Concrete, Rough Carpentry, Joint Sealants, Sheet Metal, Flashing and Trim, Access Door and Frames, Acoustical Ceiling Tile, Door Hardware, Paints and Coatings, Plumbing and Electrical.

1.05 SITE INSPECTION

- A. Contractor shall familiarize himself with the conditions at the site. No allowance will be made subsequently for any error through negligence in observing the site conditions. Contractor shall observe and make cost allowance for any mechanical and/or electrical items that must be relocated to accommodate the installation or servicing of any item covered under this contract.

ORDINANCES, REGULATIONS AND CODES

A. References to Technical Societies, Trade Organizations, Governmental Agencies is made in Division 15 in accordance with the following abbreviations.

1. AFI - Air Filter Institute
2. AMCA - Air Moving & Conditioning Association
3. ARI - Air Conditioning & Refrigeration Institute
4. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
5. ASME - American Society of Mechanical Engineers
6. ASTM - American Society of Testing Materials
7. AWS - American Welding Society Code
8. ANSI - American National Standards Institute
9. CBC - California Building Code
10. CCR - California Code of Regulations
11. CEC - California Electrical Code
12. CFC - California Fire Codes
13. CMC - California Mechanical Code
14. CPC - California Plumbing Code
15. FIA - Factory Insurance Association
16. NAFM - National Association of Fan Manufacturers
17. NEMA - National Electrical Manufacturer's Association
18. NFPA - National Fire Protection Association
19. ORS - Office of Regulatory Services
20. SCAQMD - South Coast Air Quality Management District
21. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
22. UFC - Uniform Fire Code
23. UL - Underwriter's Laboratories
24. UPC - Uniform Plumbing Code

B. Requirements of Regulatory Agencies: Materials and installation shall comply with applicable local, state, and national codes and ordinances. Rulings and interpretations of the enforcing agencies shall be considered as part of the local codes. No extras will be permitted for furnishing items required by the local codes but not specified or shown on the drawings.

C. Codes and Standards:

1. IBC and California Amendments (California Building Code - Part 2, Title 24, CCR).
2. UMC and California Amendments (California Mechanical Code - Part 4, Title 24 CCR).
3. UPC and California Amendments (California Plumbing Code - Part 5, Title 24 CCR).
4. Uniform Fire Code with State Amendments (California Fire Code - Part 9, Title 24 CCR).

5. National Fire Protection Associations - National Fire Code.

- D. Nothing in these drawings and specifications is to be construed to permit work in violation thereof. Ordinances, regulations and codes are to be construed as minimum requirements.
- E. The responsibility of the Architect to conduct construction reviews of the Contractor's performance is not intended to include the adequacy of the Contractor's safety measures in, on, or near the construction site.
- F. Ventilating, refrigeration and electrical equipment and appliances are required to be approved by the Underwriters' Laboratories, Inc., or other nationally recognized testing agency and installed per the testing agency's specifications.

1.07 PERMITS, FEES AND INSPECTIONS

- A. Obtain and pay for all necessary permits, fees, assessments, complimentary drawings, required by any legally constituted public authorities having jurisdiction.

1.08 DRAWINGS AND SPECIFICATIONS

- A. The Architect's decision will be final on interpretation of the Drawings and Specifications.
- B. The Drawings and Specifications are complimentary. Any work called for on the Drawings and not mentioned in the Specifications, or vice versa, shall be performed as though fully set forth in both.
- C. Piping, ductwork and other equipment shown as existing has been taken from the Owner's drawings. Contractor shall verify exact location in field before proceeding with the work.
- D. Where codes, standards, drawings or specifications conflict, the most stringent shall prevail, unless prior approval for variance is obtained. Specific details on the drawings shall supercede the specification in the event of a conflict.
- E. Alternate support or seismic detail proposed by contractor shall have prior approval by the Architect; and the Contractor shall obtain agency approval without any additional cost or time to the contract and without any time penalty on the work schedule.

1.09 SUBMITTALS

- A. Before starting work, the Contractor shall furnish for the approval of the Architect, Shop Drawings and Submittals with Itemized Equipment Lists, complete in all details that they proposes to install. All items shall be submitted at the same time.
- B. Submittals must be specific to this project with respect to model number, capacities, performance, etc., generic submittals will not be accepted.
- C. Variations or deviations on submitted items from that specified must be clearly tagged and / or identified
- D. Submittals shall include, but not necessarily be limited to the following which are mandatory:
 - 1. Draw Equipment Layouts to ¼" scale, including equipment, piping accessories, and showing clearances for operating and servicing.
 - 2. Schedule of pipe, fittings, valves, with manufacturer and catalog number.
 - 3. Specialties, valves, gauges and thermometers of all types.
 - 4. Foundations, supports, hangers, inserts.
 - 5. Earthquake supports and calculations.
 - 6. Insulation.
 - 7. Ventilation and air conditioning equipment, specialties and the air control systems.
 - 8. Fans, fan characteristic curves, fan tests.

9. Dampers, grilles, registers, diffusers.
10. Shop fabrication drawings and installation drawings of ductwork and piping layouts. Submit for approval prior to fabrication. Drawings shall indicate dimensions from bottom of piping and ductwork to finish floor level.
11. Wiring diagrams, control panel board, motor starters and controls for electrically operated equipment furnished by mechanical trades.
12. Automatic control system diagrams.
13. Access panels.
14. Hangers, inserts, supports, anchors.
15. Pipe, fittings and specialties.
16. Pipe isolators.
17. Sleeves, escutcheons, caulking, waterproofing, fireproofing.
18. Expansion joints, guides and anchors.
19. Shop fabrications drawings and calculations.
20. Special and miscellaneous products furnished under this section and not listed herein.

1.10 RECORD DRAWINGS AND MANUALS

- A. Record Set During the Work: At site, maintain at least one set of Drawings as a Field Record Set. Also maintain at least one copy of all Addenda, Modifications, approved submittals, correspondence, and transmittals at site. Keep Drawings and data in good order and readily available to Architect and Owner.
- B. Changes: Clearly and correctly mark Record Drawings to show changes made during the construction process at the time the changed work is installed. No such changes shall be made in the work unless authorized by the Architect.
- C. Final Record Drawings: Conform to Division 01 requirements.
- D. Preparation of Final Record Drawings: Contractor shall transfer recorded changes in the work indicated on the Field Record Set to the record set. Changes shall be neatly and clearly drawn and noted by skilled draftsmen, and shown technically correct.
- E. Approval: Prior to Architect's inspection for Substantial Completion, submit the Final Record Drawings to the Architect for review, and make such revisions as may be necessary for Final Record Drawings to be a true, complete, and accurate record of the work.
- F. Manuals: Obtain data from the various manufacturers and submit instruction, operation, and maintenance manuals as required and to the extent required under other Sections.
- G. Contents: Each manual shall have an index listing the contents. Information in the manuals shall include not less than:
 1. General introductions and overall equipment description, purpose, functions and simplified theory of operation.
 2. Specifications
 3. Installation instructions, procedures, sequences, and precautions, including tolerances for level, horizontal and vertical alignment.
 4. Grouting requirements.
 5. List showing lubricants for each item of mechanical equipment and recommended lubrication intervals.

6. Start-up and beginning operation procedures.
 7. Operational procedures.
 8. Shutdown procedures.
 9. Maintenance and calibration procedures
 10. Parts lists
 11. Name, address and telephone number of each manufacturer's local representative.
- H. Manual Submittals: Unless otherwise specified, each submittal shall include two copies of each manual, one of which will be returned to the Contractor, marked to show the required review. When approved, deliver four copies to Architect unless otherwise specified.
- I. "As-Built" drawings of ductwork and piping, including all elbows, transitions, damper and valve locations shall be provided prior to commencement of air and water balance.

1.11 QUALITY OF EQUIPMENT, MATERIALS AND WORKMANSHIP

- A. Unless otherwise specified, equipment and materials used in the installation shall be new and in perfect condition when installed. Articles provided for the same general purpose or use shall be of the same make. Workmanship shall be of the best quality and none but competent mechanics skilled in their trades shall be employed. Furnish the services of an experienced superintendent, who shall be constantly in charge of the work, together with all necessary journeymen, helpers and laborers required.

1.12 SEISMIC DESIGN

- A. Contractor shall be responsible for anchors and connections of mechanical work to the building structure including calculations for approval by structural engineer or for approval by inspector of record, as applies, for items or work, where approval is deferred or where alternate support or anchorage detail is proposed to prevent damage as a result of an earthquake, including manufactured equipment, the connection and integrity of shop fabricated and field fabricated materials and equipment. The anchorage of all pipes, ducts, conduits, fixtures, equipment, etc. shall withstand the lateral forces and shall accommodate calculated building displacement as required by the California Building Code, and local city/county codes. (Building equipment and connections therefore shall be designed to resist lateral seismic forces equal to 1.0 of equipment weight to working allowable stress. Cantilever posts supporting equipment shall be designed to resist lateral seismic forces equal to 0.5 of equipment weight to allowable working stress. Conform to the following:
1. In accordance with Title 24, 2022 CBC Chapter 16A, details shall be provided for the seismic anchorage of all mechanical and electrical equipment, anchorage details shall be based upon appropriate design calculations.
 2. For equipment weighing 400 pounds or more anchorage details and appropriate design calculations shall be submitted as part of the mechanical and electrical drawings. "Deferred Approval" items will not be permitted unless specifically approved by the plan check supervisor.
 - a. Exception: Attachments of equipment weighting less than 400 pounds and supported directly on the floor or roof structure, furniture, or temporary or movable equipment and equipment weighing less than 20 pounds that is supported by vibration isolation devices suspended from the roof, wall or floor, need not be detailed on the plans provided the following notes are included on the mechanical and electrical plans.
 3. The seismic anchorage of mechanical and electrical equipment shall conform to C.C.R. Title 24, 2022 CBC Chapter 16A. Anchorage details for roof/floor-mounted equipment shall be shown on plans.

1.13 SUBSTITUTIONS AND CHANGES

- A. The design has been based on data from certain manufacturers, suitable for each application. Recommendations for alternative manufacturers are made for each product, except when "no substitutions permitted" is indicated.
- B. It is the intent of the Owner to have this project constructed with materials, products and system originally designed and specified into the project.
- C. Alternatives that may require the modification, realignment and/or adjustment of other associated components, including impact on other trades, shall be accomplished at no additional cost or time to the contract and shall have the approval of the Architect.
- D. Substitutions shall be submitted addressing all features listed in the specifications. Features that deviate from the plans and specifications shall be clearly identified including justification for deviations. Design West Engineers will review initial submittal on substitutes only. Subsequent submittals made to correct deficiencies in original submittals will be reviewed at Contractor's expense based on Design West Engineer's hourly rate for engineering services.
- E. Should the Contractor elect to propose substitutions for the Owner's interest, the substitutions shall be in compliance with Division 01.

1.14 SUBMITTAL REVIEWS

- A. The Architect will have the right to accept or reject equipment, materials, workmanship, tests and determine when the Contractor has complied with the requirements herein specified.

1.15 SELECTION AND ORDERING OF EQUIPMENT AND MATERIALS

- A. Immediately after award of the Contract and after the final review of submittals by the Architect and / or Engineer, the Contractor shall arrange for the purchase and delivery of equipment and materials required, in ample quantities and at the proper time to meet the construction schedule. The contractor shall deliver to the Architect and Owner a complete list of equipment and materials ordered, giving descriptions, plate numbers, brochures, name of the wholesalers, date of the orders and approximate delivery dates.

1.16 LOCATIONS AND ACCESSIBILITY

- A. Drawings show pipe and ductwork diagrammatically. Conform to Drawings as closely as possible in layout work. Vary run of piping, run and shape of ductwork and make offsets during progress of work as required to meet structural and other interferences as reviewed by Architect and / or Engineer. Install piping and ductwork to best suit field conditions after coordinating with other trades. Run exposed piping and ductwork parallel to, or at right angle to, building walls. Keep horizontal lines as close to bottom of structures as possible. Conform to ceiling heights established on Drawings.
- B. Install equipment in such a manner as to be readily accessible for maintenance and repairs. Install piping, ducts and conduit in such a manner as to preserve headroom, avoid obstructions and keep openings and passageways clear.
- C. Installation at valves, thermometers, gauges, cleanouts, dampers, controls, steam and water specialties, duct access doors or any other indicating equipment or specialties requiring reading, adjustment, inspection, maintenance shall be conveniently and accessible located with reference to the finished building.
- D. Where wall and ceiling access doors are required but not shown, such doors shall be furnished under other sections and as directed by the Architect. Coordinate this requirement with appropriate trade.
- E. If changes in the indicated locations or arrangements are required, they shall be made without additional charges.

- F. In an existing area, where required, remove, reinstall, reconnect or replace, etc., any existing work to accommodate new work without any additional cost to the Owner. Material shall match existing, unless otherwise specified or approved in writing by the Architect.
- G. Provide sheaves and belts if required, to Test, Adjust and Balance Agency, to allow air moving equipment to meet flow requirements specified at no additional cost to the Owner.

1.17

COORDINATION OF TRADES

- A. Contractor shall coordinate all trades in the interest of obtaining the most practical overall arrangement of equipment, piping, conduit, and ducts and to maintain maximum headroom and accessibility.
- B. No extras will be allowed for changes made necessary by interference or coordination between trades.
- C. Submit Composite Coordination Drawings in accordance with Submittal Procedures. Include dimensioned plans, elevations, sections and details and give complete information particularly as to the kinds and types of materials and equipment, size and location of sleeves, inserts, attachments, chases, openings, conduits, ducts, boxes, lighting, structural interferences. Coordinate these Composite Coordination Drawings and field layouts in the field for proper relationship to work of applicable trades based on field conditions. Contractor shall have competent personnel readily available for coordinating, checking, and supervision of field layouts. The procedures for submittals and resubmittals, and final distribution shall be as specified in Division 01. Do not start installation of work involved under Composite Coordination Drawings until the Architect reviews applicable submittal. Discrepancies between the Drawings and Composite Coordination Drawings shall be specifically noted and identified on the Composite Coordination Drawings. Drawings for the various trades involved shall be submitted as required and reviewed prior to preparation of Composite Coordination Drawings.
 - 1. Equipment Foundations and Bases: Furnish certified details and drawings for approval before fabrication. Furnish parts necessary for each foundation sub base and support.
 - 2. Pipe Sleeves and Inserts: Furnish and install pipe sleeves and pipe support inserts before concrete is poured.
 - 3. Roof, Wall and Floor Openings: Furnish Shop Drawings showing exact locations and sizes of openings through roofs, walls and floors.
 - 4. Concrete: Conform to Concrete Section of the Specifications.

1.18

GUARANTEES

- A. Contractor shall guarantee workmanship, equipment and materials installed under his contract for a period of not less than one (1) year from the date of Substantial Completion. Should any defects occur during this period, the Contractor shall promptly repair or replace the defective item and any other damage caused to the building free of charge to the Owner, including cost of labor and materials.
- B. Guarantee included in this section to cover:
 - 1. Faulty or inadequate design of equipment or material installed
 - 2. Improper assembly or erection
 - 3. Defective workmanship or material
 - 4. Incorrect or inadequate operation or other failure
- C. The contractor shall guarantee the complete and perfect operation of the entire system and that equipment will be supported in such a way as to be free of objectionable vibration and noise

- D. Furnish the parts and labor to replace any items found to be defective in the mechanical equipment with the guarantee period.
- E. In addition to other guarantees, furnish free maintenance for the refrigeration equipment, including replacement of refrigerant and oil, for a period of one (1) year. This shall include regular monthly maintenance and "On Call" service if required.
- F. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty and proof of shipment date or purchase date per terms of warranty to the Owner, who shall be named as beneficiary.

1.19 PROTECTION OF EQUIPMENT AND MATERIALS

- A. Provide adequate storage facilities for equipment and materials on the site and shall make provisions to protect such materials and equipment from damage.

1.20 CLOSING-IN OF UNINSPECTED WORK

- A. Contractor shall not allow or cause any of the work, specifically ductwork and piping, to be covered up or enclosed until it has been inspected, tested, and approved by the Architect. Should any of work be covered up or enclosed before such inspection and test, he shall at his own expense, uncover the work and after it has been inspected, tested, and approved, make repairs with such materials as may be necessary to restore work to its original and proper condition.

1.21 BUILDING FOOTING CLEARANCES

- A. Under no circumstances shall pipes, ducts, or conduits penetrate footings. They shall cross below footings or through sleeves above footings. Those running parallel to footings shall have the minimum clearance from the cone of influence indicated on the Drawings or as required by Code.

1.22 DAMAGE BY LEAKS

- A. Contractor shall be responsible for all damage to any part of the premises caused by rain leaks through or around ducts or pipes, leaks or breaks in piping, equipment or fixtures furnished or installed by him for a period of one (1) year from the date of Substantial Completion.

1.23 EQUIPMENT LABELS

- A. Equipment provided under this Section shall be provided with the manufacturer's metal identification labels attached to each individual piece of equipment showing complete performance characteristics, size, model and serial number.

1.24 PRELIMINARY OPERATION

- A. Should the Owner request that any portion of the plant, apparatus, or equipment be operated for the Owner's beneficial use prior to the final completion and acceptance of the work, the Contractor shall conform to Beneficial Occupancy Provisions of the General Conditions. Such operation shall be under the supervision and direction of the Contractor. Such preliminary operation shall not be construed as an acceptance of any of the work.

1.25 ELECTRICAL WORK

- A. Coordinate with Division 26 in making the line and low voltage electrical connections and be responsible for the operation of the equipment furnished under this section.
- B. Voltage for electrical work will be included in Division 26. However, any control wiring which is required that is not shown on the control diagram shall be as described under this Section. In the event that the Contractor chooses to provide equipment that requires extra expense in the power or control wiring, he shall pay additional electrical costs.

- C. Safety switches, starters, circuit breakers, unless provided as a portion of package equipment, and the electrical connections of mechanical equipment to the electrical power service shall be provided under Division 26.
- D. Interconnecting wiring, safety switches, relays, controllers and motor starters which are integral components of packaged equipment shall be provided as an integral part of that equipment.
- E. All interconnecting power wiring and conduits shall be provided by Division 26.
- F. Control wiring shall be provided by Division 23, unless otherwise indicated on the drawings.
- G. Conduit for control wiring shall be provided by Division 26.

END OF SECTION

SECTION 23 05 23
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Applications.
- B. Ball valves.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 23 07 19 - HVAC Piping Insulation.
- C. Section 23 21 13 - Hydronic Piping.

1.03 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. SWP: Steam working pressure.
- I. TFE: Tetrafluoroethylene.

1.04 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose (Inch) 2013 (Reaffirmed 2018).
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard 2017.
- D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves 2017.
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2018.
- F. ASME B16.34 - Valves - Flanged, Threaded and Welding End 2017.
- G. ASME B31.1 - Power Piping 2020.
- H. ASME B31.9 - Building Services Piping 2020.
- I. AWWA C606 - Grooved and Shouldered Joints 2015.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.06 QUALITY ASSURANCE

A. Manufacturer:

- 1. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Use the following precautions during storage:

- 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.
 - b. Maintain caps in place until installation.
- 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
 - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

B. Exercise the following precautions for handling:

- 1. Handle large valves with sling, modified to avoid damage to exposed parts.
- 2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 - PRODUCTS

2.01 APPLICATIONS

A. Provide the following valves for the applications if not indicated on drawings:

- 1. Throttling (Hydronic): Butterfly, Ball, Globe, and Angle.

B. Heating Hot Water Valves:

- 1. 2 NPS (50 DN) and Smaller, Brass and Bronze Valves:
 - a. Threaded ends.
 - b. Angle: Bronze disc, Class 125.
 - c. Ball: Full port, one piece, brass trim.
 - d. Swing Check: Bronze disc, Class 125.
 - e. Gate: NRS, Class 125.
 - f. Globe: Bronze disc, Class 125.

2.02 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:

- D. Valves in Insulated Piping: Provide 2 NPS (50 DN) stem extensions and the following features:
1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 2. Butterfly Valves: Extended neck.
 3. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
 3. Pipe Flanges and Flanged Fittings 1/2 NPS (15 DN) through 24 NPS (600 DN): ASME B16.5.
 4. Solder Joint Connections: ASME B16.18.
 5. Grooved End Connections: AWWA C606.
- F. General ASME Compliance:
1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 2. Power Piping Valves: ASME B31.1.
 3. Building Services Piping Valves: ASME B31.9.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

END OF SECTION

SECTION 23 05 29
HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following hangers and supports for mechanical system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal-hanger shield inserts.
- B. Related Sections include the following:
 - 1. Division 05 for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 21 Section "Fire-Suppression Piping" for pipe hangers for fire-protection piping.
 - 3. Division 23 Section "Mechanical Vibration and Seismic Controls" for vibration isolation devices.
 - 4. Division 23 Section "Pipe Expansion Fittings and Loops" for flexible pipe..
 - 5. Division 23 Section "Metal Ducts" for duct hangers and supports.

1.02 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.03 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems. Not allowed for this project.
 - 4. Pipe positioning systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

C. Welding and brazing certificates.

1.05 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel." ASME Boiler and Pressure Vessel Code: Section IX.
- B. Welding: Qualify procedures and personnel according to the following:
 1. AWS D1.1, "Structural Welding Code--Steel."
 2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

1.06 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

1.07 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: ANSI/MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Galvanized, Metallic Coatings: Pre-galvanized or hot dipped.
- C. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

1.08 TRAPEZE PIPE HANGERS

- A. Description: ANSI/MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

1.09 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

1.10 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Non-staining, non-corrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

1.11 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with ANSI/MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for bare piping for noise abatement.
- F. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members notching. Provide such members with reinforcement steel straps of Kees Protecta-Plate or equal.
- G. For fastening to wood rafters and beams, or joists, furnish Grinnell figure 128 or 202 or equal pipe hanger flange fastened with drive screws. Under wood floors, 3/8 inch hanger rods shall be hung from 2 inch x 2 inch x 1/4 inch angle clips 3 inches long, with 2 staggered 10d nails, clinched over joist.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 and larger, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 8.

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
 9. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8.
 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 and larger.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 and larger, with steel pipe base stanchion support and cast-iron floor flange.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 and larger, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 2. Side-Beam Brackets (MSS Type 34): For sides of wooden beams.

- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- M. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- P. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

1.12

HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Each trapeze pipe hanger requires submittal of calculations and details.
 - 2. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 3. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
 - 1. Each metal framing system requires submittal of calculations and details.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
 - 1. Each pipe stand in requires submittal of calculations and details.
 - 2. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 3. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 for curbs specifications.

- G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
 - 1. Each equipment support requires submittal of calculations and details.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping.
- M. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- O. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

1.13 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

1.14 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

1.15 PAINTING

- A. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Nameplates.
- B. Pipe markers.
- C. Ceiling tacks.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems 2020.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials 2017.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 - PRODUCTS

1.05 IDENTIFICATION APPLICATIONS

- A. Air Terminal Units: Tags.
- B. Dampers: Ceiling tacks, where located above lay-in ceiling.
- C. Ductwork: Nameplates.
- D. Major Control Components: Nameplates.
- E. Piping: Tags.

1.06 NAMEPLATES

- A. Manufacturers:
 - 1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com/#sle.
 - 2. Seton Identification Products, a Tricor Direct Company: www.seton.com/#sle.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
 - 4. Letter Color: White.
 - 5. Letter Height: 1/4 inch (6 mm).
 - 6. Background Color: Black.
 - 7. Plastic: Comply with ASTM D709.

1.07

PIPE MARKERS

A. Manufacturers:

1. Brady Corporation: www.bradycorp.com/#sle.
2. Brimar Industries, Inc: www.pipemarker.com/#sle.
3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
4. MIFAB, Inc: www.mifab.com/#sle.
5. Seton Identification Products, a Tricor Company: www.seton.com/#sle.

B. Color: Comply with ASME A13.1.

C. 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.

1.08

CEILING TACKS

A. Manufacturers:

1. Craftmark Pipe Markers; www.craftmarkid.com/#sle.

B. Description: Steel with 3/4 inch (20 mm) diameter color coded head.

C. Color code as follows:

1. HVAC Equipment: Yellow.
2. Fire Dampers and Smoke Dampers: Red.
3. Heating/Cooling Valves: Blue.

PART 3 - EXECUTION

1.09

INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install plastic pipe markers in accordance with manufacturer's instructions.

C. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

D. Use tags on piping 3/4 inch (20 mm) diameter and smaller.

1. Identify service, flow direction, and pressure.
2. Install in clear view and align with axis of piping.
3. Locate identification not to exceed 20 feet (6 m) 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.

E. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.
- D. Commissioning activities.

1.02 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008 (Reaffirmed 2017).
- C. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing 2002.

1.03 SUBMITTALS

- A. The contractor shall procure the services of an independent Air Balance and Testing Agency, approved by the Engineer, which specializes in the balancing and testing of heating, ventilating, and air conditioning systems. The independent agency shall be certified and in good standing with the AABC.
- B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit to Architect.
 - 2. Submit to the Commissioning Authority.
 - 3. Submit six weeks prior to starting the testing, adjusting, and balancing work.
 - 4. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with Architect and other installers to sufficiently understand the design intent for each system.
 - 5. Include at least the following in the plan:
 - a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Identification and types of measurement instruments to be used and their most recent calibration date.
 - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - e. Final test report forms to be used.

- f. Expected problems and solutions, etc.
 - g. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.
 - h. Details of how TOTAL flow will be determined; for example:
 - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
 - i. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
 - j. Confirmation of understanding of the outside air ventilation criteria under all conditions.
 - k. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
 - l. Method of checking building static and exhaust fan and/or relief damper capacity.
 - m. Time schedule for deferred or seasonal TAB work, if specified.
 - n. False loading of systems to complete TAB work, if specified.
 - o. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
 - p. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - q. Procedures for formal progress reports, including scope and frequency.
 - r. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Field Logs: Submit at least twice a week to the Commissioning Authority.
- E. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- F. Progress Reports.
- G. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- 1. Submit to the the Commissioning Authority within two weeks after completion of testing, adjusting, and balancing.
 - 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 - 4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 6. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
 - 7. Include the following on the title page of each report:

- a. Name of Testing, Adjusting, and Balancing Agency.
- b. Address of Testing, Adjusting, and Balancing Agency.
- c. Telephone number of Testing, Adjusting, and Balancing Agency.
- d. Project name.
- e. Project location.
- f. Project Architect.
- g. Project Engineer.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 3. SMACNA (TAB).
 - 4. Maintain at least one copy of the standard to be used at project site at all times.
- B. A minimum of two air balance test shall be completed for the project. One shall be completed prior to any demolition is made to test existing systems in scope of work. Second test shall begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Certified by the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.

5. Duct systems are clean of debris.
 6. Fans are rotating correctly.
 7. Fire and volume dampers are in place and open.
 8. Air coil fins are cleaned and combed.
 9. Access doors are closed and duct end caps are in place.
 10. Air outlets are installed and connected.
 11. Duct system leakage is minimized.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.03

ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.04

RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
1. Running log of events and issues.
 2. Discrepancies, deficient or uncompleted work by others.
 3. Contract interpretation requests.
 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner and / or project inspector.

3.05

AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- G. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- H. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- I. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- J. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.02 inches negative static pressure in chemical storage rooms.
- K. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.06 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

3.07 COMMISSIONING

- A. Perform prerequisites prior to starting commissioning activities.
- B. Include cost for commissioning requirements in the contract price.
- C. Attend commissioning meetings scheduled by the CxA when requested. TAB will need to be present 2 weeks prior to the start of TAB to review the TAB plan/procedures and weekly/bi-weekly during the on-site TAB work.
- D. Submit the TAB plan/procedures to the CxA for review at least two weeks prior to beginning TAB work.
- E. Notify the CxA a minimum of two weeks in advance of scheduled TAB work.
- F. Where applicable, complete the Certificate(s) of Acceptance per the contract documents.
 - 1. Retain Certificate(s) of Acceptance in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - 2. Provide copies of all Certificate(s) of Acceptance to the CxA.
 - 3. Certificate(s) of Acceptance shall be conducted by companies who are certified as a Mechanical Acceptance Test Technician employer and only completed by those employees of said company who are certified to complete the respective acceptance test.
- G. Monitor and respond to Resolution Tracking Forms distributed by the CxA in order to expedite corrective actions necessary to achieve design intent.
- H. Participate in the Functional Performance Tests as required to achieve design intent.

- I. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
- J. In the presence of the Commissioning Authority, verify that:
 - 1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
 - 2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.

3.08 SCOPE

- A. Test, adjust, and balance the following:
 - 1. Existing Air Terminal Units.
 - 2. Air Inlets and Outlets.

END OF SECTION

SECTION 23 07 13
DUCT INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Duct insulation.
- B. Duct liner.

1.02 RELATED REQUIREMENTS

- A. Section 23 31 00 - HVAC Ducts and Casings: Glass fiber ducts.

1.03 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2017.
- D. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material) 2019.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
- G. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2005 (Revised 2009).
- H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or ASTM E84.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturer:

1. Knauf Insulation: www.knaufinsulation.com.
2. Johns Manville: www.jm.com.
3. Owens Corning Corporation: www.ocbuildingspec.com.
4. CertainTeed Corporation: www.certainteed.com/#sle.

- B. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/Pa s m), when tested in accordance with ASTM E96/E96M.

2.03 DUCT LINER

- A. Manufacturers:

1. Knauf Insulation: www.knaufinsulation.com.
2. Johns Manville: www.jm.com.
3. CertainTeed Corporation: www.certainteed.com/#sle.

- B. Note: Choose the liner type - Elastomeric Foam or Glass Fiber.

- C. Insulation: Incombustible glass fiber complying with ASTM C 1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer or acrylic polymer shown to be fungus and bacteria resistant by testing to ASTM G 21.

1. Apparent Thermal Conductivity: Maximum of [.24] at 75 degrees F.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that ducts have been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated ducts conveying air below ambient temperature:
 1. Finish with tape and vapor barrier jacket.
 2. Continue insulation through walls, sleeves, hangers, and other duct penetrations.

D. Insulated ducts conveying air above ambient temperature:

E. Duct and Plenum Liner Application:

1. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
2. Seal and smooth joints. Seal and coat transverse joints.
3. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.
4. Return Air Boots need to include 1-inch liner.
5. Supply ductwork downstream of existing air terminal units shall be lined 10-Feet from unit.

3.03

R-VALUE FOR INSULATION ON DUCTS SHALL BE PER TITLE-24 REQUIREMENTS

END OF SECTION

SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Piping insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Jackets and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus 2019.
- D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form 2020a.
- E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation 2019.
- F. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel 2008 (Reapproved 2018).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency. Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or ASTM E84.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

2.02 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

2.03 SEALANTS

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
 - 1. Permanently flexible, elastomeric sealant.
 - a. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
 - b. Color: White or gray.
- C. Metal Jacket Flashing Sealants:
 - 1. Fire- and water-resistant, flexible, elastomeric sealant.
 - 2. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 - 3. Color: Aluminum.

2.04 TAPE

- A. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Width: 2 inches (50 mm)
 - 2. Adhesion: 100 ounces force/inch (1.1N/mm)
 - 3. Elongation: 5
 - 4. Tensile Strength: 34 lbf/inch (6.2 N/mm)
 - 5. Thickness: 3.7 mils (0.093)

2.05 SECUREMENTS

- A. Bands:
 - 1. Stainless Steel: ASTM A240/A240M, Type 304; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with closed seal.
 - 2. Aluminum: ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with closed seal.

3. Springs: Twin spring set constructed of stainless steel, with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.

2.06 GLASS FIBER, RIGID

A. Manufacturers:

1. CertainTeed Corporation: www.certainteed.com.
2. Johns Manville Corporation: www.jm.com.
3. Knauf Insulation: www.knaufinsulation.com.
4. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: www.ocbuildingspec.com.

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.

1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
2. Maximum Service Temperature: 850 degrees F (454 degrees C).
3. Maximum Moisture Absorption: 0.2 percent by volume.

2.07 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
2. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 - a. Thickness: 0.016 inch (0.40 mm) sheet.
 - b. Finish: Smooth.
 - c. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
 - d. Fittings: 0.016 inch (0.4 mm) thick die shaped fitting covers with factory attached protective liner.
 - e. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Install insulation continuously through hangers and around anchor attachments.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- L. Install multiple layers of insulation with longitudinal and end seams staggered.
- M. Exposed Piping: Locate insulation and cover seams in least visible locations.
- N. Insulated pipes conveying fluids below ambient temperature; insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- O. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- P. Install insulation on piping accessories requiring future re-occurring access and service with factory fabricated insulation covers that are easily removed and reapplied.
- Q. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- R. Glass fiber insulated pipes conveying fluids above ambient temperature.
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- S. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.
- T. Insulation Installation at Roof and exterior wall penetrations continuously through penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof or exterior wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof or exterior wall flashing at least 2

inches (50 mm) below top of roof or wall flashing.

4. Seal jacket to roof or wall flashing with flashing sealant.

- U. Insulation Installation at Underground Exterior Wall Penetrations. Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- V. In fire rated and non-fire rated installation install insulation continuously through walls, floors, and partitions.
- W. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with canvas jacket sized for finish painting.
- X. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

END OF SECTION

SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Hydronic system requirements.
- B. Heating water piping, above grade.
- C. Pipe hangers and supports.
- D. Unions, flanges, mechanical couplings, and dielectric connections.

1.02 REFERENCE STANDARDS

- A. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications 2019.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2016.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2018.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2018.
- E. ASME B31.9 - Building Services Piping 2020.
- F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.
- G. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service 2019.
- H. ASTM A536 - Standard Specification for Ductile Iron Castings 1984 (Reapproved 2019)e1.
- I. ASTM B32 - Standard Specification for Solder Metal 2020.
- J. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2020.
- K. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.
- L. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 2015, with Editorial Revision (2018).
- M. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) 2020.
- N. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 2021.
- O. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 2020.
- P. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets 2020.
- Q. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers 1992, with Editorial Revision (2018).
- R. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications 2007 (Reapproved 2019).
- S. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding 2011

(Amended 2012).

- T. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- U. AWWA C606 - Grooved and Shouldered Joints 2015.
- V. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.
- C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- D. Project Record Documents: Record actual locations of valves.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
- B. Welder Qualifications: Certify in accordance with ASME BPVC-IX.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.06 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 - PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping system shall be tested at a minimum of 125 PSI or 1.5 times the working pressure, whichever is greater per ASME B31.9 Standards.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
 - 1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.
- D. Valves: Provide valves where indicated:
 - 1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch (20 mm) ball valves with cap; pipe to nearest floor drain.
 - 2. On discharge of condenser water pumps, use spring loaded check valves.

3. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings.
4. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.
5. For throttling and isolation service in chilled and condenser water systems, use only butterfly valves.
6. For shut-off and to isolate parts of systems or vertical risers, use gate, ball, or butterfly valves.

2.02 HEATING WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
 2. Welded Joints: ASME IX Article V Appendix E
 3. Threaded Joints: ASME B16.3, malleable iron fittings.
 4. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:
 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
 2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

2.03 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized; using one of the following joint types:
 1. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:
- C. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.
 1. Fittings: ASTM D2466 or D2467, PVC.
 2. Joints: Solvent welded in accordance with ASTM D2855.

2.04 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
- B. Conform to ASME B31.9.
- C. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
- D. Hangers for Cold Pipe Sizes 2 Inches (50 mm) and Greater: Carbon steel, adjustable, clevis.

- E. Hangers for Hot Pipe Sizes 2 to 4 Inches (50 to 100 mm): Carbon steel, adjustable, clevis.
- F. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- G. Vertical Support: Steel riser clamp.
- H. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- I. Floor Support for Hot Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- J. Floor Support for Hot Pipe Sizes 6 Inches (150 mm) and Greater: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- K. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- L. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- M. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- N. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
 - 1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - 2. Height: Provide minimum clearance of 6 inches (150 mm) under pipe to top of roofing.
 - 3. Manufacturers:
 - a. PHP Systems/Design; www.phpsd.com/#sle.

2.05

UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

- A. Unions for Pipe 2 Inches (50 mm) and Less:
 - 1. Ferrous Piping: 150 psig (1034 kPa) malleable iron, threaded.
 - 2. Copper Pipe: Bronze, soldered joints.
- B. Flanges for Pipe 2 Inches (50 mm) and Greater:
 - 1. Ferrous Piping: 150 psig (1034 kPa) forged steel, slip-on.
 - 2. Copper Piping: Bronze.
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 - 1. Grooved-End-Tube Couplings
 - a. Include ferrous housing sections cast with offsetting, angle pattern bolt pads, coated with copper-colored enamel, EDPM-synthetic rubber gaskets of a Flush Seal design suitable for hot and cold water, bolts and nuts. Victaulic Style 606
 - 2. Grooved-End-Tube Flange Adapters
 - a. Ductile-iron casting, coated with copper-colored enamel, flat-faced, for engaging into roll grooved copper tube and fittings and bolting directly to flanges with ANSI Class 125 and 150 bolt hole patterns. Victaulic Style 641

3. Grooved-End-Tube Mechanical-T
 - a. Bronze upper housing and copper-colored enamel coated ductile iron lower housing, threaded outlet and locating collar, EPDM synthetic rubber gasket suitable for hot and cold water, and bolts and nuts. Victaulic Style 622
4. Dimensions and Testing: In accordance with AWWA C606.
5. Mechanical Couplings: Comply with ASTM F1476.
6. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C).
7. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
8. When pipe is field grooved, provide coupling manufacturer's grooving tools.
9. Flaring of tupe and fitting ends to IPS dimensions is not permitted
10. Manufacturers:
 - a. Victaulic Company; www.victaulic.com/#sle.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment using jointing system specified.
- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Group piping whenever practical at common elevations.
- E. Sleeve pipe passing through partitions, walls and floors.
- F. Slope piping and arrange to drain at low points.
- G. All exposed, unfinished pipe, fittings, supports, and accessories shall be painted, all exterior piping shall have approved UV protection.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
- I. Inserts:
 1. Provide inserts for placement in concrete formwork.
 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 4. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

J. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
 2. Support horizontal piping as scheduled.
 3. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
 4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
 5. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- K. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 19.
- L. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 3100.
- M. Provide stem extensions for all valves on systems with pipe insulation such that the valve can be cycled without damaging pipe insulation.
- N. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 91 23.

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Metal ductwork.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- B. Section 23 07 13 - Duct Insulation: External insulation and duct liner.
- C. Section 23 33 00 - Air Duct Accessories.
- D. Section 23 37 00 - Air Outlets and Inlets.

1.03 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 2020.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.
- C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2018.
- D. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2018.
- E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2005 (Revised 2009).
- F. SMACNA (FGD) - Fibrous Glass Duct Construction Standards 2003.
- G. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors current edition, including all revisions.

1.04 PERFORMANCE REQUIREMENTS

- A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.05 SUBMITTALS

- A. Product Data: Provide data for duct materials, duct liner, and duct connections.
- B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.06 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 - PRODUCTS

2.01 DUCT ASSEMBLIES

- A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.

2.02

MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.
- B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - 2. VOC Content: Not more than 250 g/L, excluding water.
 - 3. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
- C. Flexible Ducts:
 - 1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
 - a. Pressure Rating: 10 inches WG (2.50 kPa) positive and 1.0 inches WG (250 Pa) negative.
 - b. Maximum Velocity: 4000 fpm (20.3 m/sec).
 - c. Temperature Range: -20 degrees F to 210 degrees F (-28 degrees C to 99 degrees C).
- D. Insulated Flexible Ducts:
 - 1. O
 - a. Pressure Rating: 10 inches WG (2.50 kPa) positive and 1.0 inches WG (250 Pa) negative.
 - b. Maximum Velocity: 4000 fpm (20.3 m/sec).
 - c. Temperature Range: -20 degrees F to 210 degrees F (-28 degrees C to 99 degrees C).
- E. Return and Relief: 1 inch w.g. (250 Pa) pressure class, galvanized steel.
- F. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
- G. Hanger Rod: ASTM A 36/A 36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.03

DUCTWORK FABRICATION

- A. Fabricate ductwork gauge in accordance with current (CMC) California Mechanical Code and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. Tee's, bends, and elbows: Construct according to (CMC) California Mechanical Code and SMACNA (DCS).
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).
- F. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

- G. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.04 DUCT MANUFACTURERS

- A. Metal-Fab, Inc: www.mtlfab.com.
- B. SEMCO Incorporated: www.semcoinc.com.
- C. United McGill Corporation: www.unitedmcgill.com.

2.05 MANUFACTURED DUCTWORK AND FITTINGS

- A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install in accordance with manufacturer's instructions.
- C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- D. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- E. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- F. 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.
- G. Locate ducts and dampers with sufficient space around equipment to allow normal operating and maintenance activities.
- H. Use crimp joints with or without bead for joining round duct sizes 8 inch (200 mm) and smaller with crimp in direction of air flow.
- I. Use double nuts and lock washers on threaded rod supports.
- J. Connect terminal units to supply ducts directly or with one foot (300 mm) maximum length of flexible duct. Do not use flexible duct to change direction.
- K. Connect diffusers or light troffer boots to low pressure ducts directly or with 7 feet maximum length of flexible duct held in place with strap or clamp.
- L. At exterior wall louvers, seal duct to louver frame and install blank-out panels.
- M. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.02 CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Duct test holes.
- C. Flexible duct connections.
- D. Volume control dampers.

1.02 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2018.
- B. NFPA 92 - Standard for Smoke Control Systems 2018.
- C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2005 (Revised 2009).
- D. UL 33 - Safety Heat Responsive Links for Fire-Protection Service Current Edition, Including All Revisions.
- E. UL 555 - Standard for Fire Dampers Current Edition, Including All Revisions.
- F. UL 555S - Standard for Smoke Dampers Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, and hardware used. Include electrical characteristics and connection requirements.
- B. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.

1.04 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 - PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

- A. Manufacturers:
 - 1. Krueger-HVAC, Division of Air System Components: www.krueger-hvac.com/#sle.
 - 2. PCI Industries, Inc; Pottorff Brand : www.portorff.com.
 - 3. Ruskin Company: www.ruskin.com/#sle.
 - 4. Titus HVAC, a brand of Johnson Controls: www.titus-hvac.com/#sle.
- B. Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with worm drive mechanism with removable key operator.

2.02 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.03 FLEXIBLE DUCT CONNECTIONS

- A. Manufacturers:
 - 1. Ductmate Industries, Inc, a DMI Company: www.ductmate.com/#sle.
 - 2. Elgen Manufacturing, Inc: www.elgenmfg.com/#sle.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Flexible Duct Connections: Fabric crimped into metal edging strip.

2.04 VOLUME CONTROL DAMPERS

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc, a brand of Mestek, Inc: www.louvers-dampers.com/#sle.
 - 2. Nailor Industries, Inc: www.nailor.com/#sle.
 - 3. PCI Industries, Inc; Pottorff Brand : www.portorff.com.
 - 4. Ruskin Company: www.ruskin.com/#sle.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch (150 x 760 mm).
- D. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 31 00 for duct construction and pressure class.
- B. Provide duct test holes where indicated and required for testing and balancing purposes.
- C. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- D. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- E. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Diffusers.
- B. Registers/grilles.

1.02 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2015.
- B. ARI 890 - Standard for Air Diffusers and Air Diffuser Assemblies; Air-Conditioning and Refrigeration Institute; 2008.
- C. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets 2006 (Reaffirmed 2011).
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2005 (Revised 2009).

1.03 SUBMITTALS

- A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.04 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Price Industries: www.price-hvac.com.
- B. Krueger: www.krueger-hvac.com.
- C. Titus: www.titus-hvac.com.

2.02 ROUND CEILING DIFFUSERS

- A. Type: Round, adjustable pattern, stamped or spun, multi-core diffuser to discharge air in 360 degree pattern, with sectorizing baffles where indicated. Diffuser collar shall project not more than 1 inch (25 mm) above ceiling. In plaster ceilings, provide plaster ring and ceiling plaque.
- B. Fabrication: Steel with baked enamel finish.
- C. Color: As indicated.

2.03 RECTANGULAR CEILING DIFFUSERS

- A. Type: Provide square and rectangular, adjustable pattern diffuser to discharge air in four way pattern with sectorizing baffles where indicated.
- B. Frame: Surface mount type. In plaster ceilings, provide plaster frame and ceiling frame.
- C. Fabrication: Aluminum with baked enamel off-white finish.

2.04 CEILING SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.
- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket.
- C. Fabrication: Aluminum extrusions with factory off-white enamel finish.
- D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.05 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing, with blades set at 45 degrees, vertical face.
- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting.
- C. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

2.06 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, horizontal face.
- B. Fabrication: Steel with steel frames and blades, with factory baked enamel finish.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting.
- D. Color: To be selected by Architect from manufacturer's standard range.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

3.02 SCHEDULES SHOWN ON SHEET M001

END OF SECTION

SECTION 26 00 10

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SCOPE

- A. This section supplements all sections of this division and shall apply to all phases of work hereinafter specified, shown on the drawings, or required to provide a complete installation of electrical systems for the Project. The work required under this division is not limited to the electrical specifications and drawings. Refer to all bid documents including Civil, Architectural, Structural, and Mechanical documents which may designate Work to be accomplished. The intent of the Specifications is to provide a complete and operable electrical system, which shall include all documents that are a part of the entire Project Contract.
 - 1. Work included: Furnish all labor, material, tools, equipment, facilities, transportation, skilled supervision necessary for, and incidental to, performing operations in connection with furnishing, delivery, and installation of the work in this division complete as shown or noted on the Drawings and specified herein.
- B. Related Work Specified Elsewhere:
 - 1. Refer to all sections in the general contract conditions, Contract Requirements and Division 1, General Requirements.
- C. Work Installed but Furnished by Others:
 - 1. The electrical work includes the installation or connection of certain materials and equipment furnished by others. Verify installation details. Foundations for apparatus and equipment will be furnished by others unless otherwise noted or detailed.

1.02 GENERAL REQUIREMENTS

- A. Guarantee See General Conditions:
 - 1. Except as may be specified under other Sections in the specification, guarantee equipment furnished under the specifications for a period of one year, except for equipment required to have a longer guarantee period, from date of final completion. Guarantee all work against defective workmanship, material, and improper installation. Upon notification of failure, correct deficiency immediately and without additional cost to the Owner.
 - 2. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner or his service agency as approved. Furnish to the Owner, through the Architect, printed manufacturer's warranties complete with material included and expiration dates, upon completion of project. Conform to Division 01.
- B. Equipment Safety: All electrical materials and equipment shall be new and shall be listed by Underwriter's Laboratories and bear their label, or listed and certified by a nationally recognized testing authority where UL does not have an approval. Custom made equipment must have complete test data submitted by the manufacturer attesting to its safety.
- C. Codes and Regulations:
 - 1. Design, manufacturer, testing and method of installation of all apparatus and materials furnished under the requirements of these specifications shall conform to the latest publications or standard rules of the following:
 - a. Institute of Electrical and Electronic Engineers - IEEE

- b. National Electrical Manufacturers' Association - NEMA
- c. Underwriters' Laboratories, Inc. - UL
- d. National Fire Protection Association - NFPA
- e. American Society for Testing and Materials - ASTM
- f. American National Standards Institute - ANSI
- g. California Electrical Code - CEC, Title 24, Part 3
- h. California Code of Regulations, Title 8, Subchapter 5
- i. California Building Code-CBC, Title 24 Parts 1 & 2
- j. State & Municipal Codes in Force in the Specific Project Area
- k. Occupational Safety & Health Administration - OSHA
- l. California State Fire Marshal
- m. California Fire Code- CFC, Title 24 Part 9
- n. National Electrical Testing Association - NETA

2. The term "Code", when used within the specifications, shall refer to the Publications, Standards, ordinances and codes, listed above. In the case where the codes have different levels of requirements the most stringent rules shall apply.

D. Requirements of Regulatory Agencies:

1. Codes, Permits, and Fees: Where the Contract Documents exceed minimum requirements, the Contract Documents take precedence. Where code conflicts occur, the most stringent shall apply. The most stringent condition shall be as interpreted by the Engineer.
 - a. Comply with all requirements for permits, licenses, fees and Code. Permits, licenses, fees, inspections and arrangements required for the Contractor at his expense shall obtain the Work, unless otherwise specified.
 - b. Comply with the requirements of the applicable utility companies serving the Project. Make all arrangements with the utility companies for proper coordination of the Work.

E. Shop Drawings:

1. See Division 01 for additional requirements.
2. Time Schedules for Submission and Ordering: The Contractor shall prepare, review and coordinate his schedule of submissions carefully, determining the necessary lead time for preparing, submitting, checking, ordering and delivery of materials and equipment for timely arrival. The Contractor shall be responsible for conformance with the overall construction schedule.
3. Submittals will be checked for general compliance with specifications only. The Contractor shall be responsible for deviations from the drawings or specifications and for errors or omissions of any sort in submittals.
4. Submit a complete list of materials and equipment proposed for the job, including manufacturers names and catalog numbers.
5. Shop drawings shall be submitted in completed groups of materials (i.e., lighting fixtures or switchgear). The Contractor shall add and sign the following paragraph on equipment and materials submitted for review. "It is hereby certified that the (equipment) (material) shown and marked in this submittal is that proposed to be

incorporated into the project; is in compliance with the Contract Drawings and specifications and can be installed in the allocated spaces". Failure to add the above written statement for compliance will result in return of submittals without review.

- a. Bind catalog cuts, plate numbers, descriptive bulletins and drawings, 11" x 17" (275 mm x 435 mm) or smaller, in sets with covers neatly showing titles.
 - b. The Contractor shall verify dimensions of equipment and be satisfied as to Code compliance for fit prior to submitting shop drawings for approval.
 - c. Where current limiting devices are specified, submit technical data to substantiate adequate protection of equipment cascaded downstream. Submittals shall not be reviewed unless supporting calculations and data are submitted therewith.
 - d. Include complete catalog information such as construction, ratings, insulation systems, as applicable.
 - e. For any material specified to meet UL or trade standards, furnish the manufacturers or vendor's certification that the material furnished for the work does in fact equal or exceed such specifications.
 - f. Reference listings to the specifications' Sections and Article to which each is applicable.
 - g. Equipment Floor Plans: After approval of material is secured prepare a floor plan of each electrical and communication equipment space, room or yard, drawn to scale at 1/2 inch equals 1 foot and submit for approval in the same manner as for shop drawings. The layout drawings shall be exact scale.
6. Contractor shall prepare coordinated drawings when required by Division 01 or where noted otherwise.
- F. Interpretations: The Contractor through the Architect must make Requests for interpretations of drawings and specifications. Any such requests made by equipment manufacturers or suppliers will be referred to the Contractor.
- G. Standard of Quality
1. The contract Drawings and Specifications establish the "MINIMUM STANDARD OF QUALITY" each product and/or system must meet to be considered acceptable. Products of other manufactures will be considered if the product and/or system meet or exceed the "MINIMUM STANDARD OF QUALITY" established by this Contract Document.
 2. Items for similar application shall be of the same manufacturer.
 3. The label of listing by UL shall appear on all materials and equipment for which standards have been established by the agency.
 4. Where codes as listed in Section General Requirement Section of the Specifications that establish label or approved requirements, furnish all materials and equipment with either the required labels affixed or the necessary written approval.
 5. Provide the type and quantity of electrical materials and equipment necessary to complete Work and all systems in operation, tested and ready for use.
 6. Provide and install all incidental items that belong to the Work described and which are required for complete systems.
 7. All switchboards, distribution boards, panel boards and circuit breakers shall be of the same manufacturer.

8. All wiring devices such as switches and receptacles shall be of the same manufacturer.
- H. Substitutions: Refer to Division 01
- I. Submit comprehensive material list, shop drawings and complete technical data for the following equipment and materials:
1. General Requirements:
 - a. Main service and distribution switchboards.
 - b. Panelboards.
 - c. Conduits
 - d. Conductors, include all selected insulation types.
 - e. Fuses
 - f. Disconnect switches and Starters.
 - g. Pullboxes, manholes and handholes.
 - h. Standard lighting fixtures, specially fabricated fixtures, ballasts and lamps, with samples and sample of standard finish available (where requested).
 - i. Control devices, standard and special receptacles, switches, outlets and finish device plates.
 - j. Cabinets for signal and telephone system, special terminals and cabinets. Include all cabinet dimensions.
 - k. Fire alarm system.
 - l. Transformers
- J. Utility Service:
1. Contractor shall verify the locations shown on the drawings and shall include extensions of lines to building service from locations which are acceptable to the Owner.
 2. Verify electrical, civil, architectural and structural, dimensional and other requirements with the Owner.
 3. Should any major modifications to the work indicated be necessary to comply with the Owner requirements, notify the Architect.
 4. Contractor shall contact the utility company representatives to establish pre-construction coordination, obtain all necessary meters and/or approvals, and schedule utility work to coordinate with the construction schedule.
 5. All utility services shall be installed per the utility company requirements. Verify final construction requirements with utility company service planners prior to construction.
- K. Record Drawings: Refer to Division 01, Contract Closeout.
- L. Work Responsibilities:
1. The drawings indicate diagrammatically the desired locations or arrangement of conduit runs, outlets, junction boxes and equipment and are to be followed. Execute the work so as to secure the best possible installation in the available space and to overcome local difficulties due to space limitations. The Contractor is responsible for the correct placing of his work. Where conflicts occur in plans and/or specifications, the most stringent application shall apply and shall be part of the base bid.

2. Locations shown on architectural plan or on wall elevations shall take precedence over electrical plan locations, but where a major conflict is evident, notify the Architect.
 3. In the event minor changes in the indicated locations or arrangement are necessary due to developed conditions in the building construction or rearrangement of furnishings or equipment or due to interference with other trades, such changes shall be made without extra cost.
 4. Verify dimensions and the correct location of Owner-Furnished equipment before proceeding with the roughing-in of connections.
 5. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with work carefully check and verify dimensions and sizes with the drawings to see that the furnished equipment will fit into the spaces provided without violation of applicable Codes.
 6. Should any changes to the work indicated on the drawings or described in the specifications be necessary in order to comply with the above requirements, notify the Architect.
 7. Contractor shall be responsible for coordination of coordinated drawings when required by the Architect.
 8. Replace or repair, without additional compensation any work which does not comply with or which is installed in violation of any of these requirements.
- M. Installation General: For special requirements, refer to specific equipment under these requirements.
1. Unless otherwise specified elsewhere in the specifications, do all excavating necessary for the proper installation of the electrical work.
 2. Locations of Openings: Locate chases, shafts and openings required for the installation of the electrical work during framing of the structure. Do any additional cutting and patching required. Cutting or drilling in any structural member is prohibited without approval of the Architect. Furnish all access panels to make all boxes, connections and devices accessible as required by CEC.
 3. Location of Sleeves: Where conduits pass through concrete walls, suspended slabs or metal deck floors, install sleeves of adequate size to permit installation of conduit. Sleeves shall be installed prior to pouring of concrete and shall have ends flush with the wall or extend 2 inches above floor surfaces. Verify locations.
 4. Wherever conduit extends through roof, install flashings in accordance with drawings and details.
 5. Contractor shall be responsible for cutting and patching which may be required for the proper installation of the electrical work.
 6. Protect work, materials and equipment and provide adequate and proper storage facilities during the progress of the work. Storage outdoors shall be weather protected and shall include space heaters to prevent condensation. Provide for the safety and good condition of all work until final acceptance of the work. Replace all damaged or defective work, materials and equipment before requesting final acceptance.
 7. Conduit and Equipment to be Installed: Clean thoroughly to remove plaster, spattered paint, cement and dirt on both exterior and interior. All underground conduits shall be mandrelled prior to pulling wire.
 8. Conduit and Equipment to be Painted: Clean conduit exposed to view in completed structure by removing plaster and dirt. Remove grease, oil and similar material from

conduit and equipment by wiping with clean rags and suitable solvents in preparation for paint.

9. Items with Factory Finish: Remove cement, plaster, grease and oil, and leave surfaces, including cracks and corners, clean and polished. Touch up scratched or bare spots to match finish.
10. Site Cleaning: Remove from site all packing cartons, scrap materials and other rubbish on a weekly basis. Vacuum out all cabinets, switchgear and panels and junction boxes prior to pulling any conductors.
11. Electrical equipment and materials exposed to public and in finished areas shall be finish-painted after installation in accordance with the Painting Section. All exposed screw-type fasteners, exterior, or interior in restrooms, shall be vandal-resistant spanner type; include tool.

N. Excavation, Cutting and Patching:

1. Excavating, trenching and backfilling required for the work of this Division in accordance with the applicable requirements of Division 2. Excavating and backfilling connected with electrical work, repaving cuts and providing and maintaining protective measures for the electrical work excavation required by the governing authorities having jurisdiction shall be performed as a part of the work of this Division.
2. Verify openings indicated on the drawings. Provide all cutting, patching and reinforcement of the construction of the building as required to install electrical work.

O. Tests

1. Equipment and systems for which the National Electrical Testing Association (NETA) has an approved or recommended procedure, shall be tested in accordance with that procedure. Test values shall equal values recommended by NETA. Copies of test reports shall be submitted as required under shop drawing submittals.
2. Resistance to ground tests shall be accomplished by a qualified independent testing firm to measure resistance to ground at grounding electrodes. Make tests before slabs or affected areas are poured in order that corrective measures, if required, may be taken. Submit a report showing the results of these measurements. If the resistances exceed values specified elsewhere or NETA test procedure recommendations, perform corrective measures required to reduce resistance to acceptable values.
3. Prior to energizing any motor, measure the service voltage for phase balance and report if unbalance exceeds 1% from mean.
4. Measure the three-phase voltage at no load and at maximum load conditions and submit to the engineer a report showing the results of these measurements.
5. Upon completion of the work and adjustment of all equipment, conduct an operating test. Conduct the test in the presence of an authorized representative of the Owner's Representative. Demonstrate system and equipment to operate in accordance with requirements of the Contract Documents and to be free from electrical and mechanical defects. Provide systems free from short circuits and grounds and show an insulation resistance between phase conductors and ground not less than the requirements of the governing electric code. Test circuits for proper neutral connection.
6. Complete tests prior to final inspection of project, including corrective work based on the results of the tests.
7. Perform special tests on systems and equipment as specified herein using personnel qualified to perform such tests.

P. Protection: Protect finish parts of the materials and equipment against damage during the progress of the work and until final completion and acceptance. Cover materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred. Keep moving parts clean, dry and lubricated.

Q. Cleaning Up:

1. Upon completion of the work and at various time during the progress of the work, remove from the building all surplus materials, rubbish and debris resulting from the work of this Division.
2. Thoroughly clean switchgear including busses, apparatus, exposed conduit, metal work including the exterior and interior, and accessories for the work of this Division, of cement, plaster and other deleterious materials; remove grease and oil spots with cleaning solvent; carefully wipe surfaces and scrape cracks and corners clean.
3. Thoroughly polish chromium or plated work. Remove dirt and stains from lighting fixtures.
4. Leave the entire installation in a clean condition.

R. Completion:

1. The work will not be reviewed for final acceptance until operating and maintenance data, manufacturer's literature, panel directories and nameplates specified herein have been approved and properly posted or installed and final cleaning of equipment and premises has been completed.
2. When the installation is complete and adjustments have been made, operate the system for a period of one week, during which time demonstrate that systems are completed and operating in conformance with the specifications.

S. Operating and Maintenance Data: Submit complete and at one time, prior to acceptance of the installation, 4 copies of manufacturer's instructions for operation and maintenance of electrical equipment, including replacement parts lists. As specified in Division 01

T. Inspection and Acceptance Procedures: The Architect will submit observation reports periodically during the construction phase detailing Contract deficiencies. The Contractor is responsible for making corrections immediately. Notice of Completion of the project will not be made until all items have been corrected.

U. Final Completion of Electrical Systems:

1. Prior to Final Completion of operating electrical systems, the Contractor shall:
 - a. Provide materials of the type and quality specified and as necessary for proper operation, tested and ready for use.
 - b. Furnish the required Operating and Maintenance Data/Manuals.
 - c. Clean up of the project pertaining to this Division of the work.
 - d. After installation has been completed and adjustments made, operate the system for a period of one week, during which time, demonstrate to the Architect that systems are complete and operating in conformance with Contract Documents.
 - e. Conduct tests required and as specified in this Division and submit test reports and corrective actions taken.
 - f. Submission of warranties and guarantees.
2. Final Completion of Work Shall be Contingent On:
 - a. Contractor replacing defective materials and workmanship.

- b. Upon completion of work and adjustments made, Contractor shall conduct an operating test for each system for approval at such time as Architect directs. Conduct test in presence of authorized representative of Architect and demonstrate that systems and equipment do operate in accordance with requirements of the Contract Documents and are free from electrical and mechanical defects.
 - c. Contractor shall provide the necessary training programs and instructions to the Owner's representative. Number of hours shall be a minimum of four (4) hours for each system or days as required under separate Sections of these Specifications. Complete operation and maintenance manuals shall be provided at least two (2) weeks prior to training.
 - d. Submit copies of manufacturer's instructions and maintenance of electrical equipment including replacement parts lists. Each set shall include one set of shop drawings of equipment installed.
- V. Submittals for Change Orders: When changes are made during the construction phase, deletions and additions shall be presented in a manner that will indicate the cost of each item of material and corresponding labor. Markup shall be then added in accordance with the requirements of the General Conditions as modified by the Supplementary Conditions.
- W. The Contractor at a time convenient to the Owner shall provide instruction to the Owner's operating personnel in the proper operation and maintenance of all equipment and systems. The instructors shall have received factory training and shall be thoroughly familiar with the equipment installed. The operating personnel shall receive the number of days instruction as indicated in other sections.

1.03

PROJECT RECORD DOCUMENTS

- A. Record Drawings: CAD: Use a computer aided drafting (CAD) system in the preparation of record drawings for this Project. Acceptable CAD systems shall be capable of producing files in AutoCAD Version 2012 compatible DWG or DXF format. Owner's consultant will furnish CAD backgrounds for use by the Contractor after construction is 85% complete except where prohibited by Contract.
- B. Record Set During the Work: At site, maintain at least one set of Drawings as a Field Record Set. Also maintain at least one copy of all Addenda, Modifications, approved submittals, correspondence, and transmittals at site. Keep Drawings and data in good order and readily available to Architect and Owner.
- C. Changes: Clearly and correctly mark Record Drawings to show changes made during the construction process at the time the changed work is installed. No such changes shall be made in the work unless authorized by the Architect.
- D. Final Record Drawings: Conform to Division 01 requirements.
- E. Preparation of Final Record Drawings: Contractor shall transfer recorded changes in the work indicated on the Field Record Set to the record set. Changes shall be neatly and clearly drawn and noted by skilled draftsmen, and shown technically correct.
- F. Approval: Prior to Architect's inspection for Substantial Completion, submit the Final Record Drawings to the Architect for review, and make such revisions as may be necessary for Final Record Drawings to be a true, complete, and accurate record of the work.
- G. Manuals: Obtain data from the various manufacturers and submit instruction, operation, and maintenance manuals as required and to the extent required under other Sections.
- H. At all times when the work is in progress, maintain at the workplace, fabrication shop or Project Site as applies, a complete separate, clean, undamaged set of the latest stamped, actioned submittals. As work progresses, maintain records of "as installed" conditions on this set in suitable ink or chemical fluid. Update the set daily. After successful completion of

Project Site testing specified herein, and after completion of Punch List corrections, copy all records of "as installed" conditions on to originals.

- I. Quantity:
 - 1. Review sets: As for Shop and Field Drawings.
 - 2. Record set: Refer to Division 01.
- J. Content: All drawings required under "Field and Shop Drawings". Show "as installed" condition. Where room designations according to Project permanent signage differ from construction designations in the Contract Documents, show both designations.
- K. Warranty Certificates: Comply with Division 01.

PART 2 - COMMISSIONING

2.01 COMMISSIONING OF ELECTRICAL SYSTEMS

- A. Include cost for commissioning requirements in the contract price.
- B. Attend commissioning meetings scheduled by the CxA.
- C. Prepare preliminary schedule for indoor lighting system inspections, O&M manual submission, training sessions, lighting controls testing, system verification, performance testing, and system completion for use by the CxA. Update schedule as appropriate throughout the construction period and provide updated schedule to the commissioning team.
- D. Verify proper installation and performance of all electrical services provided.
- E. Complete Title 24 Certificate(s) of Installation and manufacturer's pre-start checklists prior to scheduling startup of HVAC and electrical equipment.
 - 1. Retain Certificate(s) of Installation in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - 2. Make Certificate(s) of Installation available for CxA review upon request.
 - 3. Retain calibration records for equipment provided with manufacturer calibrated sensors in the Certificate(s) of Installation binder.
- F. Where applicable, complete the Certificate(s) of Acceptance per the contract documents.
 - 1. Retain Certificate(s) of Acceptance in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - 2. Provide copies of all Certificate(s) of Acceptance to the CxA.
 - 3. Certificate(s) of Acceptance shall be conducted by companies who are certified as California Advanced Lighting Controls Training Program Acceptance Technician (CALCTP-AT) employer and only completed by those employees of said company who are certified to complete the respective acceptance test.
- G. Monitor and respond to Resolution Tracking Forms distributed by the CxA in order to expedite corrective actions necessary to achieve design intent.
- H. Participate in the Certificate(s) of Acceptance and Functional Performance Tests as required to achieve design intent.
- I. Participate in the opposite-season testing as required to achieve design intent.
- J. Participate in O&M Training as required by project specifications.
- K. Ensure participation of major equipment manufacturers and their representatives as applicable.

- L. Obtain O&M data on all equipment and assemble in binders using tabs as required.
- M. Conduct a maintenance orientation and inspection with hands on training per the contract documents.
- N. Provide written certification and completed Certificate(s) of Installation forms and checklists documenting that the following work has been completed in accordance with the plans and specifications and that they are functioning as designed.
 - 1. Correct labeling of all circuits with connected equipment.
 - 2. Lighting system controls operations, including occupancy sensors, automatic time controls or Energy Management control, override timers, manual dimming controls, exterior lighting controls, multi-level switching, as applicable to the Work.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single conductor building wire.
- B. Wiring connectors.
- C. Electrical tape.
- D. Heat shrink tubing.
- E. Wire pulling lubricant.
- F. Cable ties.

1.02 RELATED REQUIREMENTS

- A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011 (Reapproved 2017).
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.
- F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2020.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
- I. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- L. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- M. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.
- N. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- O. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.

- P. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- Q. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- B. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is not permitted.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.

- C. Provide new conductors and cables manufactured not more than one year prior to installation.
- D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- E. Comply with NEMA WC 70.
- F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- H. Conductor Material:
 - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
 - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 - 3. Tinned Copper Conductors: Comply with ASTM B33.
- I. Minimum Conductor Size:
 - 1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
 - 3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
 - 4) 20A exterior circuits: 10 AWG..
 - 2. Control Circuits: 14 AWG.
- J. Conductor Color Coding:
 - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 - 2. Color Coding Method: Integrally colored insulation.
 - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
 - 3. Color Code:
 - a. 480Y/277 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral/Grounded: Gray.
 - b. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.

- c. Equipment Ground, All Systems: Green.

2.03

SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:

1. Copper Building Wire:

- a. Cerro Wire LLC: www.cerrowire.com/#sle.
- b. Encore Wire Corporation: www.encorewire.com/#sle.
- c. Southwire Company: www.southwire.com/#sle.
- d. Rome Wire and Cable.
- e. Okonite Wire
- f. Pirelli Wire and Cable
- g. Carol Cable

B. Description: Single conductor insulated wire.

C. Conductor Stranding:

1. Feeders and Branch Circuits:

- a. Size 10 AWG and Smaller: Solid.
- b. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:

1. Copper Building Wire: Type THHN/THWN-2, except as indicated below.

- a. Size 4 AWG and Larger: Type XHHW-2.
- b. Installed Underground: Type XHHW-2.

2.04

WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Wiring Connectors for Splices and Taps:

- 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
- 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

C. Wiring Connectors for Terminations:

- 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
- 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
- 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
- 4. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.

- D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
- G. Mechanical Connectors: Provide bolted type or set-screw type.
- H. Compression Connectors: Provide circumferential type or hex type crimp configuration.

2.05

ACCESSORIES

- A. Electrical Tape:
 - 1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
 - 2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
 - 3. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
 - 4. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
 - 5. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.
- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
- C. Wire Pulling Lubricant:
 - 1. Listed and labeled as complying with UL 267.
 - 2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
 - 3. Suitable for use at installation temperature.
- D. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.01

EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:

1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated without specific routing, determine exact routing required.
3. Arrange circuiting to minimize splices.
4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Installation in Raceway:

1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
2. Pull all conductors and cables together into raceway at same time.
3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

G. Install conductors with a minimum of 12 inches of slack at each outlet.

- H. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- K. Make wiring connections using specified wiring connectors.
 - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 - 3. Do not remove conductor strands to facilitate insertion into connector.
 - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 - 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- L. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
 - 1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 - 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
 - 3. Wet Locations: Use heat shrink tubing.
- M. Insulate ends of spare conductors using vinyl insulating electrical tape.
- N. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- O. Identify conductors and cables in accordance with Section 260553.
- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section Firestopping.
- Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.04

FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.

- B. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
- C. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.
- F. Ground access wells.

1.02 RELATED REQUIREMENTS

- A. Section 096500 - Resilient Flooring: Static control flooring.
- B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- B. Field quality control test reports.

- C. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding System Resistance:
 - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System: Not greater than 25 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
- F. Grounding Electrode System:
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - 2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
 - 3. Metal In-Ground Support Structure:

- a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
- 4. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
- 5. Ground Rod Electrode(s):
 - a. Provide two electrodes unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - c. Provide ground access well for each electrode.
- 6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
- 7. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
 - a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
 - b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
 - c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
- G. Service-Supplied System Grounding:
 - 1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 - 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- H. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
 - 1. Provide grounding electrode system for each separate building or structure.
 - 2. Provide equipment grounding conductor routed with supply conductors.
 - 3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
 - 4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.
- I. Separately Derived System Grounding:
 - 1. Separately derived systems include, but are not limited to:
 - a. Transformers (except autotransformers such as buck-boost transformers).
 - 2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.

3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
5. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.
6. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
7. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

J. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.
 - c. Metal process piping.
8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame.
10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.

K. Communications Systems Grounding and Bonding:

1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.

2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
 - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
 - b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.
 - c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 260526:

1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

D. Ground Bars:

1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:

1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

F. Ground Access Wells:

1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.
4. Cover: Factory-identified by permanent means with word "GROUND".

PART 3 EXECUTION

3.01

EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02

INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70.
- D. Make grounding and bonding connections using specified connectors.
 - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- E. Identify grounding and bonding system components in accordance with Section 260553.

3.03

FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.13.
- C. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
 - 2. Coordinate work to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
 - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
 - 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 033000.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.
- B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

1.05 QUALITY ASSURANCE

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with the following. Where requirements differ, comply with most stringent.
 - a. NFPA 70.
 - b. Requirements of authorities having jurisdiction.
2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
6. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.

1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

D. Metal Channel/Strut Framing Systems:

1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
2. Comply with MFMA-4.
3. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.

E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

F. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
2. New Concrete: Use preset concrete inserts.

3. Existing Concrete: Use expansion anchors.
4. Solid or Grout-Filled Masonry: Use expansion anchors.
5. Hollow Masonry: Use toggle bolts.
6. Hollow Stud Walls: Use toggle bolts.
7. Steel: Use welded threaded studs complying with AWS D1.1/D1.1M with lock washers and nuts or Beam clamps (MSS Type 19 21 23 25 or 27) complying with MSS SP-69.
8. Sheet Metal: Use sheet metal screws.
9. Wood: Fasten with lag screws or through bolts.
10. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
11. Plastic and lead anchors are not permitted.
12. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
 - b. Comply with MFMA-4.
 - c. Channel Material: Use galvanized steel.
13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1.
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

H. Equipment Support and Attachment:

1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

I. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

J. Secure fasteners in accordance with manufacturer's recommended torque settings.

K. Remove temporary supports.

3.03

CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete or Cast-in-Place Concrete (Limited Applications)" as applicable.

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturers written instructions.

3.04

FIELD QUALITY CONTROL

A. Inspect support and attachment components for damage and defects.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 26 05 33.13

CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. PVC-coated galvanized steel rigid metal conduit (RMC).
- C. Flexible metal conduit (FMC).
- D. Liquidtight flexible metal conduit (LFMC).
- E. Galvanized steel electrical metallic tubing (EMT).
- F. Reinforced thermosetting resin conduit (RTRC).

1.02

REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- E. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- F. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit; 2018.
- G. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series; 2015.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- J. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- K. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
- L. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- M. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- N. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

1.03

ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.

4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- B. Project Record Documents: Record actual routing for conduits installed underground and conduits 2 inch (53 mm) trade size and larger.

1.05 QUALITY ASSURANCE

- A. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 1. Under Slab on Grade: Use rigid PVC conduit.
 2. Exterior, Direct-Buried: Use rigid PVC conduit.
 3. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or schedule 80 rigid PVC conduit where emerging from underground.
 4. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use PVC-coated galvanized steel rigid metal conduit elbows for bends.
 5. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth where soil has resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
 6. Where galvanized rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) emerges from concrete into soil, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities

having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches on either side of where conduit emerges.

- D. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).
- E. Concealed Within Hollow Stud Walls: Use electrical metallic tubing (EMT).
- F. Concealed Above Accessible Ceilings: Use electrical metallic tubing (EMT).
- G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.
- H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit or electrical metallic tubing (EMT).
- I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.
 - 1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
- J. Exposed, Exterior: Use galvanized steel rigid metal conduit.
- K. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit.
- L. Corrosive Locations Above Ground: Use stainless steel rigid metal conduit (RMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), stainless steel electrical metallic tubing (EMT), or reinforced thermosetting resin conduit (RTRC).
- M. Hazardous/Classified Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit (RMC).
- N. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
 - 1. Maximum Length: 6 feet.
- O. Flexible Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit (FMC).
 - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
 - 3. Maximum Length: 6 feet unless otherwise indicated.
 - 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.
- P. Fished in Existing Walls, Where Necessary: Use flexible metal conduit (FMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

2.02

CONDUIT - GENERAL REQUIREMENTS

- A. Comply with NFPA 70.
- B. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- C. Provide products listed, classified, and labeled as suitable for purpose intended.
- D. Minimum Conduit Size, Unless Otherwise Indicated:

1. Branch Circuits: 3/4 inch (21 mm) trade size.
2. Branch Circuit Homeruns: 3/4-inch trade size.
3. Control Circuits: 1/2-inch trade size.
4. Flexible Connections to Luminaires: 3/8-inch trade size.
5. Underground, Exterior: 1-inch trade size.

E. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
2. Material: Use steel or malleable iron.
3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.04 STAINLESS STEEL RIGID METAL CONDUIT (RMC)

2.05 STAINLESS STEEL INTERMEDIATE METAL CONDUIT (IMC)

2.06 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch.

C. PVC-Coated Boxes and Fittings:

1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
4. Material: Use steel or malleable iron.
5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch.

D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch.

2.07 FLEXIBLE METAL CONDUIT (FMC)

A. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.

2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- B. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.

2.09 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- B. Fittings:
 - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Material: Use steel or malleable iron.
 - 3. Connectors and Couplings: Use compression/gland or set-screw type.
 - a. Do not use indenter type connectors and couplings.

2.10 STAINLESS STEEL ELECTRICAL METALLIC TUBING (EMT)

2.11 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)

- A. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).
- B. Supports: As recommended by manufacturer.
- C. Fittings: Same type and manufacturer as conduit to be connected.

2.12 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch.
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
- C. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- D. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

- D. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by manufacturer.
- E. Conduit Routing:
1. Unless dimensioned, conduit routing indicated is diagrammatic.
 2. When conduit destination is indicated without specific routing, determine exact routing required.
 3. Conceal conduits unless specifically indicated to be exposed.
 4. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 5. Arrange conduit to maintain adequate headroom, clearances, and access.
 6. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
 7. Arrange conduit to provide no more than 150 feet between pull points.
 8. Route conduits above water and drain piping where possible.
 9. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 10. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
 11. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
 - c. Flues.
 12. Group parallel conduits in same area on common rack.
- F. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 260529.
 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
 4. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
 5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
 7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.

8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
9. Use of spring steel conduit clips for support of conduits is not permitted.
10. Use of wire for support of conduits is not permitted.

G. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
7. Secure joints and connections to provide mechanical strength and electrical continuity.

H. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
6. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
7. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 078400.

I. Underground Installation:

1. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 18 inches.
 - b. Under Slab on Grade: 12 inches to bottom of slab.
2. Provide underground warning tape in accordance with Section 260553 along entire conduit length.

- J. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section Concrete with minimum concrete cover of 3 inches on all sides unless otherwise indicated.

- K. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
 - 1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 - 2. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
 - 3. Where conduits are subject to earth movement by settlement or frost.
- L. Conduit Sealing:
 - 1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
 - 2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
 - a. Where conduits pass from outdoors into conditioned interior spaces.
 - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- M. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- N. Provide grounding and bonding; see Section 260526.
- O. Identify conduits; see Section 260553.

3.03

FIELD QUALITY CONTROL

- A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- B. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- C. Correct deficiencies and replace damaged or defective conduits.

3.04

CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.05

PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 26 05 33.16

BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

1.02 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- J. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
 - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
 - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
 - 6. Coordinate the work with other trades to preserve insulation integrity.
 - 7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.

8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for floor boxes and underground boxes/enclosures.
- B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 016000 - Product Requirements, for additional provisions.
 2. Keys for Lockable Enclosures: Two of each different key.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 BOXES

- A. General Requirements:
 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 3. Use suitable concrete type boxes where flush-mounted in concrete.
 4. Use suitable masonry type boxes where flush-mounted in masonry walls.
 5. Use raised covers suitable for the type of wall construction and device configuration where required.
 6. Use shallow boxes where required by the type of wall construction.
 7. Do not use "through-wall" boxes designed for access from both sides of wall.
 8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.

11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
12. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
 - c. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
13. Wall Plates: Comply with Section 262726.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
 1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
 - b. Back Panels: Painted steel, removable.
 - c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Box Locations:
 1. Locate boxes to be accessible. Provide access panels in accordance with Section Access Panels as required where approved by the Architect.
 2. Unless dimensioned, box locations indicated are approximate.
 3. Locate boxes as required for devices installed under other sections or by others.

- a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 262726.
- 4. Locate boxes so that wall plates do not span different building finishes.
- 5. Locate boxes so that wall plates do not cross masonry joints.
- 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
- 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
- 8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
- 9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
 - b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
- 10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 260533.13.
- 11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.
 - c. Electrical rooms.
 - d. Mechanical equipment rooms.

H. Box Supports:

- 1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
- 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.

I. Install boxes plumb and level.

J. Flush-Mounted Boxes:

- 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
- 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.

3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

- K. Install boxes as required to preserve insulation integrity.
- L. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- M. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- N. Close unused box openings.
- O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- P. Provide grounding and bonding in accordance with Section 260526.

3.02 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.03 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Warning signs and labels.

1.02 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- B. Section 262726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.

1.03 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011 (Reaffirmed 2017).
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011 (Reaffirmed 2017).
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.
- E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- B. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.

a. Switchboards:

- 1) Identify ampere rating and name.
- 2) Identify voltage and phase.
- 3) Identify power source and circuit number. Include location when not within sight of equipment.
- 4) Use identification nameplate to identify main overcurrent protective device.
- 5) Use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.

b. Panelboards:

- 1) Identify ampere rating and name.
- 2) Identify voltage and phase.
- 3) Identify power source and circuit number. Include location when not within sight of equipment.
- 4) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
- 5) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.

c. Transformers:

- 1) Identify kVA rating and name.

2. Service Equipment:

a. Use identification nameplate to identify each service disconnecting means.

3. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.

- a. Service equipment.
- b. Industrial control panels.
- c. Motor control centers.
- d. Elevator control panels.
- e. Industrial machinery.

4. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
 - a. Minimum Size: 3.5 by 5 inches.
 - b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.

B. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. At each source and load connection.
 - b. Within boxes when more than one circuit is present.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.

C. Identification for Raceways:

1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
2. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
4. Use underground warning tape to identify underground raceways.

D. Identification for Boxes:

1. Use voltage markers to identify highest voltage present.
2. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
 - a. For exposed boxes in public areas, use only identification labels.

E. Identification for Devices:

1. Wiring Device and Wallplate Finishes: Comply with Section 262726.
2. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.

- a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
- 3. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.

F. Identification for Luminaires:

- 1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.02

IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

- 1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
- 2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
 - a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
- 3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
- 4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
- 5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:

- 1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
- 2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:

- 1. Minimum Size: 1 inch by 2.5 inches.
- 2. Legend:
 - a. Equipment designation or other approved description.
- 3. Text: All capitalized unless otherwise indicated.
- 4. Minimum Text Height:
 - a. Equipment Designation: 1/2 inch.
 - b. Other Information: 1/4 inch.
- 5. Color:
 - a. Normal Power System: White text on black background.

D. Format for Caution and Warning Messages:

1. Minimum Size: 2 inches by 4 inches.
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/2 inch.
 5. Color: Black text on yellow background unless otherwise indicated.
- E. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
 2. Legend: Power source and circuit number or other designation indicated.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch.
 5. Color: Black text on clear background.
- F. Format for Control Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
 2. Legend: Load controlled or other designation indicated.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch.
 5. Color: Black text on clear background.

2.03

WIRE AND CABLE MARKERS

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- E. Minimum Text Height: 1/8 inch.
- F. Color: Black text on white background unless otherwise indicated.

2.04

VOLTAGE MARKERS

- A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- C. Minimum Size:
 1. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 2. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
 3. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- D. Legend:

1. Markers for Voltage Identification: Highest voltage present.
- E. Color: Black text on orange background unless otherwise indicated.

2.05 UNDERGROUND WARNING TAPE

- A. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color:

2.06 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
 1. Materials:
 2. Minimum Size: 7 by 10 inches unless otherwise indicated.
- C. Warning Labels:
 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
 3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 1. Surface-Mounted Equipment: Enclosure front.
 2. Flush-Mounted Equipment: Inside of equipment door.
 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 4. Elevated Equipment: Legible from the floor or working platform.
 5. Branch Devices: Adjacent to device.
 6. Interior Components: Legible from the point of access.
 7. Conduits: Legible from the floor.
 8. Boxes: Outside face of cover.
 9. Conductors and Cables: Legible from the point of access.
 10. Devices: Outside face of cover.

- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Mark all handwritten text, where permitted, to be neat and legible.

3.03

FIELD QUALITY CONTROL

- A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 26 05 83

WIRING CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical connections to equipment.

1.02 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.04 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Comply with NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- 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.

END OF SECTION

SECTION 26 08 02

INSTALLATION & ACCEPTANCE TESTING OF ELECTRICAL SYSTEMS

INTRODUCTION

1.01 TITLE 24 REQUIRES THE COMPLETION OF ALL APPLICABLE CERTIFICATES OF INSTALLATION AND CERTIFICATES OF ACCEPTANCE FOR LIGHTING SYSTEMS. THIS SHALL INCLUDE INDOOR AND OUTDOOR LIGHTING SYSTEMS.

1.02 RELATED DOCUMENTS

- A. Contract drawings and specifications, general provisions of the contract, including general and supplementary conditions, electrical provisions and Division-1 Specification sections apply to work of this section.

1.03 DESCRIPTION OF WORK

- A. Complete all Title 24 required Certificate(s) of Installation (NRCI) and Certificate(s) of Acceptance (NRCA) to be completed per the contract documents.

1.04 RESPONSIBILITIES OF INSTALLING CONTRACTORS

A. General Contractor (GC)

1. Ensure that all contractors identified as the contractor responsible for acceptance testing and completion of the Title 24 Certificate(s) of Acceptance are certified by the State of California or its designated body to conduct each respective test.

B. Electrical Contractor (EC)

1. Verify proper installation and performance of all electrical services provided.
2. Meet with acceptance tester at beginning of construction to review project requirements.
3. Complete Title 24 Certificate(s) of Installation and manufacturer's pre-start checklists prior to scheduling startup/programming of lighting control equipment.
 - a. Retain Certificate(s) of Installation in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - b. Make Certificate(s) of Installation available for building inspector's review.
 - c. Retain calibration records for equipment provided with manufacturer calibrated sensors in the Certificate(s) of Installation binder.
 - d. Correct labeling of all circuits with connected equipment.
4. Complete the Certificate(s) of Acceptance per the contract documents.
 - a. The company installing the lighting systems must be an authorized Lighting Controls Acceptance Test Employer certified by a Lighting Controls Acceptance Test Technician Certification Provider or include in their bid the cost of retaining and overseeing a contractor who is an authorized Lighting Controls Acceptance Test Employer to complete the acceptance testing.
 - b. All required acceptance testing must be completed by a Lighting Controls Acceptance Test Technician employed by the Lighting Controls Acceptance Test Employer. The acceptance tester shall be present for all commissioning efforts.

- c. Retain Certificate(s) of Acceptance in a 3-ring binder in an organized fashion. Binder is to remain on the job site
 - d. Upload all Certificate(s) of Acceptance to the California Title 24 Certificates of Acceptance database, if, at the time of project completion, the database is available to the public.
5. Successful completion of the required Acceptance Tests is the responsibility of the installing contractor. Any costs associated with modifications necessary to obtain compliance and re-testing of systems shall be included in the base bid of this project.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Occupancy sensors.
- B. Daylighting controls.

1.02 RELATED REQUIREMENTS

- A. Section 260529 - Hangers and Supports for Electrical Systems
- B. Section 260533.16 - Boxes for Electrical Systems.
- C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 262726 - Wiring Devices: Devices for manual control of lighting, including wall switches.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- D. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2020.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
 - 3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
 - 4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
 - 5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- B. Shop Drawings:
 - 1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
 - 2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.
- C. Field Quality Control Reports.
- D. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Operation and Maintenance Data: Include detailed information on device programming and setup.
- F. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. Provide five year manufacturer warranty for all occupancy sensors.
- B. Provide five year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

2.02 OCCUPANCY SENSORS

- A. All Occupancy Sensors:

1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
 2. Sensor Technology:
 - a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
 - b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
 - c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
 6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
 7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 8. Sensitivity: Field adjustable.
 9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
 10. Integral Photocell: For field selectable and adjustable inhibition of automatic turn-on of load when ambient lighting is above the selected level.
 11. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
 12. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
- B. Wall Switch Occupancy Sensors:
1. All Wall Switch Occupancy Sensors:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.

- c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
- d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
- e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.

C. Wall Dimmer Occupancy Sensors:

1. General Requirements:

- a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability, and no leakage current to load in off mode.
- b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
- c. Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
- d. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
- e. Finish: Color to be selected<>.

D. Ceiling Mounted Occupancy Sensors:

1. All Ceiling Mounted Occupancy Sensors:

- a. Description: Low profile occupancy sensors designed for ceiling installation.
- b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
- c. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
- d. Finish: White unless otherwise indicated.

2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:

- a. Standard Range Sensors: Capable of detecting motion within an area of 1000 at a mounting height of 9 feet, with a field of view of 360 degrees.

E. Power Packs for Low Voltage Occupancy Sensors:

- 1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.

2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
3. Input Supply Voltage: Dual rated for 120/277 V ac.
4. Load Rating: As required to control the load indicated on drawings.

2.03 DAYLIGHTING CONTROLS

- A. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of lighting control devices provided under this section.
 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
 2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
 3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
- C. Install lighting control devices in accordance with manufacturer's instructions.

- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- E. Install lighting control devices plumb and level, and held securely in place.
- F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 262726.
- G. Provide required supports in accordance with Section 260529.
- H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- I. Identify lighting control devices in accordance with Section 260553.
- J. Occupancy Sensor Locations:
 - 1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
 - 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- K. Daylighting Control Photo Sensor Locations:
 - 1. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
 - 2. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.
- L. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- M. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.
- N. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.
- O. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

3.04

FIELD QUALITY CONTROL

- A. Inspect each lighting control device for damage and defects.
- B. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- C. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.

D. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.05

ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

C. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

D. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

3.06

CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.07

CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
4. Location: At project site.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Wall plates and covers.

1.02 RELATED REQUIREMENTS

- A. Section 260533.16 - Boxes for Electrical Systems.
- B. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h, with Amendments (2017).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2014g, with Amendment (2017).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
 - 4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 - 5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:
 - 1. Do not install wiring devices until final surface finishes and painting are complete.

- 1.05 SUBMITTALS
- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
1. Wall Dimmers: Include derating information for ganged multiple devices.

- 1.06 QUALITY ASSURANCE
- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

- 2.01 MANUFACTURERS
- A. Hubbell Incorporated: www.hubbell-wiring.com.
- B. Leviton Manufacturing Company, Inc: www.leviton.com.
- C. Lutron Electronics Company, Inc: www.lutron.com.
- D. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us

- 2.02 WIRING DEVICE APPLICATIONS
- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide GFCI protection for receptacles installed within 6 feet of sinks.
- E. Provide GFCI protection for receptacles installed in kitchens.
- F. Provide GFCI protection for receptacles serving electric drinking fountains.
- G. Unless noted otherwise, do not use combination switch/receptacle devices.

- 2.03 WIRING DEVICE FINISHES
- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.
- C. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.
- D. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
- E. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover.

- 2.04 WALL SWITCHES
- A. Manufacturers:
1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.05

RECEPTACLES

A. Manufacturers:

1. Hubbell Incorporated: www.hubbell-wiring.com.
2. Leviton Manufacturing Company, Inc: www.leviton.com.
3. Lutron Electronics Company, Inc; Designer Style: www.lutron.com/#sle.
4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us

B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:

1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
2. Automatically Controlled Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.

D. GFCI Receptacles:

1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

PART 3 EXECUTION

3.01

EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

- F. Verify that conditions are satisfactory for installation prior to starting work.

3.02

PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03

INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of wiring devices provided under this section.
1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switches: 48 inches above finished floor.
 - b. Receptacles: 18 inches above finished floor or 6 inches above counter.
 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
 5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.
- J. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- K. Install wall switches with OFF position down.
- L. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- M. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or

improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

N. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

O. Identify wiring devices in accordance with Section 260553.

3.04 FIELD QUALITY CONTROL

A. Inspect each wiring device for damage and defects.

B. Operate each wall switch with circuit energized to verify proper operation.

C. Test each receptacle to verify operation and proper polarity.

D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

E. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.

1.02 RELATED REQUIREMENTS

- A. Section 260529 - Hangers and Supports for Electrical Systems.
- B. Section 260533.16 - Boxes for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information; 2019.
- B. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002 (Reaffirmed 2008).
- C. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2019.
- D. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- E. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems; 2006.
- F. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- G. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012 (Reaffirmed 2018).
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- K. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- L. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
 - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.

3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. Shop Drawings:

1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
2. Provide photometric calculations where luminaires are proposed for substitution upon request.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:

- a. Include estimated useful life, calculated based on IES LM-80 test data.
2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
3. Ballasts: Include wiring diagrams and list of compatible lamp configurations.
4. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.

C. Samples:

1. Provide one sample(s) of each luminaire proposed for substitution upon request.

D. Certificates for Dimming Ballasts: Manufacturer's documentation of compatibility with dimming controls to be installed.

E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
2. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
3. Extra Ballasts: Two percent of total quantity installed for each type, but not less than one of each type.

G. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. Provide five year manufacturer warranty for all LED luminaires, including drivers.
- B. Provide 5-year pro-rata warranty for batteries for emergency lighting units.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
 - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
- H. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.03 EMERGENCY LIGHTING UNITS

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

C. Battery:

1. Size battery to supply all connected lamps, including emergency remote heads where indicated.

D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.04

EXIT SIGNS

A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.

1. Number of Faces: Single- or double-face as indicated or as required for installed location.
2. Directional Arrows: As indicated or as required for installed location.

2.05

BALLASTS AND DRIVERS

A. Ballasts/Drivers - General Requirements:

1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

B. Dimmable LED Drivers:

1. Dimming Range: Continuous dimming from 100 percent to one percent relative light output unless dimming capability to lower level is indicated, without flicker.
2. Control Compatibility: Fully compatible with the dimming controls to be installed.

PART 3 EXECUTION

3.01

EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02

PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03

INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.
- B. Install products in accordance with manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).

- D. Provide required support and attachment in accordance with Section 260529.
- E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- F. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
 - 4. Secure pendant-mounted luminaires to building structure.
 - 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - 6. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- G. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
 - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
 - 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- H. Suspended Luminaires:
 - 1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
 - 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 - 3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.
 - 4. Install canopies tight to mounting surface.
- I. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- J. Install accessories furnished with each luminaire.
- K. Bond products and metal accessories to branch circuit equipment grounding conductor.
- L. Emergency Lighting Units:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- M. Exit Signs:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- N. Install lamps in each luminaire.

3.04

FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.

- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.
- C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.06 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.
- B. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 26 51 20

AUTOMATIC LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Provide and design an automatic lighting control system as described in this specification and as called for on the drawings.

1.02 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of 10 years experience in manufacturing and installing this type of system.
- B. The Contractor shall provide a list of recent jobs completed during the last 5 years with the name and phone number of a contact person.
- C. All components and assemblies are to be pre-tested and assembled at the factory prior to installation.
- D. Provide a factory-trained technician on site. The technician shall functionally test each component in the system after installation to verify proper operation and confirm that the panel wiring and addressing conform to the wiring documentation.

1.03 SUBMITTALS

- A. The following list includes the required shop drawings and product data information that shall be submitted.
 - 1. Underwriters Laboratories, Inc. (UL) listing and factory test reports.
 - 2. Internal and system wiring diagrams.
 - 3. Single line diagram of the system configuration. Typical riser diagrams are not acceptable.
 - 4. Dimensions of the equipment layout.
 - 5. Control wiring and conduits layout and connections.
 - 6. Floor plans to scale showing the location of each device and equipment.
 - 7. Product data of all the components including but not limited to programmable central controllers, transceivers panels, input relays, switches and other ancillary equipment.

1.04 REFERENCES

- A. UL 916 Energy Management Equipment.
- B. FCC Emissions Standards specified in Part 15, subpart J for Class A, Applications.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Provide and microprocessor controlled relay panels for the Lighting Control System. The system shall include programmable standalone master panel, switch inputs, wiring, power supplies, relays and ancillary relays.
- B. Panels shall be capable of standing alone or operating as part of a network.
 - 1. The system shall provide intelligence to operate as follows:

- a. Store all user operating data.
 - b. Initiate all relay output commands based on:
 - 1) Operator inputs
 - 2) Automatic operating schedule
 - 3) Binary type field sensors
 - 4) Universal override switch inputs
 - 5) Internal 56K Baud modem
 - c. Provide automatic system diagnostics and alarming based on detected faults in the controller, transceiver panels, relays, and data line.
 - 2. System shall include a memory back up to be able to survive an indefinite length of power failure.
- C. Lighting Control Panel (LCP): Microprocessor based, complete prewired assemblies consisting of the following:
- 1. Stand alone panel controller capable of receiving and acting upon programs downloaded from the central computer. Programs downloaded from the network shall be capable of continuing to operate even if the network should fail. Battery Back up provides 8 days of memory retention. Panel shall be part of a system that can control up to 750 relays and receive up to 500 switch inputs. Panel shall have an USB input for local programming and trouble shooting from a laptop computer.
 - 2. Internal digital clock with self control power.
 - 3. Output modules: Plug in type to receive coded digital commands from the panel controller and pulse output relays to the appropriate state. Actual status feedback of the relays are to be fed back to the panel controller and from there to the central computer. Actual status of each relay is to be indicated by a pilot LED on the control board. Each Module controls 8 or 16 relays.
 - 4. Switch input modules: Plug-in type, actuated by remote external contact closures. These contact closures may be either momentary or maintained. The action of the contact is noted by the panel controller and acted upon as programmed by software. The action of the contact can command any group of output relays to the desired state. Either 8 or 24-input channels as shown on the plans.
 - 5. Output Relays
 - a. Type: Momentary pulsed, mechanically latched with pilot light contact.
 - b. Rating: 20 Ampere, 277VAC
 - c. Number per panel: 16,32 or 48 as required to satisfy this project scope.
 - 6. The low voltage and high voltage sections of the lighting control cabinet shall be separated by a 14 gage steel barrier in which the relays are mounted. In areas where both 120 volt and 277 volt loads are present the high voltage compartment shall have a 14 gage steel barrier between the relays that carry 120 VAC and the relays that carry 277VAC. Each section shall be clearly labeled as to the voltage in that compartment.
 - 7. Panel power supply shall be dual primary 115/277 volts AC, 60 Hz. $\pm$ 10%. Low voltage side shall be protected from power line surges and spikes on the input power. The low voltage section shall be protected against short circuit faults and relay failures.

8. Panels shall be UL approved and shall have a short circuit withstand current rating at 14,000 AIC.
9. Manufacturer: Lighting Control and Design, or G.E. or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The Lighting Control System shall be installed and wired completely as required by the equipment manufacturer by the contractor, who shall make all necessary wiring connections to the lighting fixtures, override switches, photo cells and equipment.
- B. The Contractor shall provide on-site programming time with factory-trained personnel for the system set-up. The Contractor shall set up the software program and program the entire system in accordance with the Owner's instructions.
- C. Documentation
 1. Accurate "as-built" drawings shall be provided by the Contractor. These shall indicate the load controlled by each relay and the identification number for that switch connected to an input and the identification number of that input. Three sets of space plans or reflected ceiling plans shall be provided by the contractor indicating which fixtures are controlled by each relay.
 2. A separate data grade private line with RJ45 jack shall be furnished for each modem.

3.02 SERVICE AND SUPPORT

- A. Startup: After the system has been installed, the Contractor shall provide the services of a factory trained representative of the manufacturer to verify correct operation of all system components. The contractor shall guarantee all material and workmanship involving the system for three years after startup.
- B. Training: After system startup and after all the programming is completed, the Contractor shall arrange for a factory trained representative to train the Owner's personnel. The trainer shall instruct the Owner's personnel in how to program the system and demonstrate a typical operating program for an area. The Contractor shall allow for 24 hours' instruction time for the Owner's training.
- C. Factory Support: Factory support shall be available free of charge during the three-year warranty period to answer programming and application questions. The manufacturer, or his representative, shall have a remote terminal capable of programming the system to support the Owner's personnel during this period. The Contractor shall include a modem, necessary cabling and telephone extension to support this telecommunications operation. The Contractor shall provide a three-year maintenance service contract as part of the cost.
- D. The Contractor shall also provide a software site licensing so that the Owner will be able to transfer the software program from the main computer to the other computers. This transfer shall not be an extra cost to the Owner.

END OF SECTION

SECTION 27 00 00

COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 — GENERAL

1.01 SUMMARY

- A. This section specifies the basic requirements for Communications installations as indicated or required and includes requirements common to more than one specification section of this Division (such as related documents, related sections, definitions, governing requirements, contractor requirements, warranty requirements, submittal requirements/procedures, and project closeout requirements/procedures, as well as other requirements). This section may expand upon and/or supplement the requirements specified in Division 01.
- B. Examine the contract documents in their entirety (including Drawings and Specification sections in the other divisions) for requirements or work which may affect work under this section, regardless of whether such requirements or work are specifically indicated in this section.
- C. Errors or Omissions in Drawings or Documentation
 - 1. If any errors or omissions appear in Drawings, Specifications, or other documents, the bidding Contractor shall notify the System Designer no later than ten (10) days prior to submitting the bid.
 - 2. Should conflict occur in or between Drawings and Specifications, the bidding Contractor is deemed to have estimated the more expensive way of doing the work, unless the bidding Contractor has asked for and obtained written decision (addendum) before submission of the bid as to which method or materials will be required.
- D. Related Sections:
 - 1. Section 000000 – Procurement and Contracting Requirements
 - 2. Section 010000 – General Requirements
 - 3. Section 270526 – Grounding and Bonding for Communications Systems
 - 4. Section 270528 – Pathways for Communications Systems
 - 5. Section 270553 – Identification for Communications Systems
 - 6. Section 271116 – Communications Room Equipment
 - 7. Section 271323 – Backbone Cabling
 - 8. Section 271513 – Horizontal Cabling
 - 9. Section 271619 – Patch Cords

10. Section 271700 – Testing of Structured Cabling Systems
11. Section 274116 – Audiovisual Systems
12. Section 280000 – Common Work Results for Security Systems
13. Section 281000 – Access Control and Alarm Management Systems

1.02 DEFINITIONS

- A. ANSI – American Northern Standards Institute
- B. AWG – American Wire Gauge
- C. BICSI – Building Industry Consulting Service International
- D. BCT – Bonding Conductor for Telecommunications
- E. EIA – Electronics Industry Alliance
- F. ETL – Intertek Certification Services
- G. IEC – International Electrotechnical Commission
- H. IEEE – Institute of Electrical and Electronic Engineers
- I. IDC – Insulation displacement contact
- J. ISO – International Standards Organization
- K. NECA – National Electrical Contractors Association
- L. NFPA – National Fire Protection Agency
- M. NRTL – Nationally Recognized Testing Laboratory
- N. TIA – Telecommunications Industry Association
- O. UL – Underwriters Laboratory
- P. Provide: Furnish, install, terminate, label, test and certify a complete operating cabling system.
- Q. Contract Documents (CD): Design drawings, specifications, sketches, and schedules provided by the System Designer as they directly relate to this scope of work and this project.
- R. Structured Cabling System (SCS): A SCS is defined as all required cabling including hardware, termination blocks, cross connect wire or cordage, patch panels, patch cords, telecommunication outlets, work area cords, UTP and fiber optic cable installed and configured to provide computer data and voice connectivity from each data or voice device to the network file server or voice network/switch designated as the service point of the local area network.

- S. Point-of-Entry (POE): Unmarked Manholes/Vaults at property line
- T. NET-POP Rooms/MPOE (Main Point of Entry): The area where the outside plant media/carrier services appear in the facility. The NET-POP contains equipment used by owner or carrier to hand-off/transition cable from outside plant into inside plant type.
- U. Main Distribution Frame (MDF): This technology space houses Layer 2/3 network switching gear and other main network distribution equipment and acts as the mid-connection point between the Core/Network and the TR/IDF/access zones for all connections.
- V. Telecommunications Room (TR)/Intermediate Distribution Frame (IDF): is the location for the termination of backbone cables and for termination of horizontal cables, and for the interconnection of each. The space also hosts access-layer switches and user network connections within each floor.
- W. Active Equipment: electronic equipment used to develop various WAN, LAN, and voice services, e.g., digital multiplexers, RS-232 controllers, Ethernet hubs, switches, routers, PBX, etc.
- X. Campus Backbone: cabling system consisting of media and termination hardware interconnecting POE, Net-Pop's and Future onsite buildings.
- Y. Building Backbone: cabling system consisting of media and termination hardware interconnecting MDFs to IDFs.
- Z. Horizontal Cabling: cabling system consisting of media and termination hardware interconnecting the Telecommunication Outlets (TOs) and the TRs.
- AA. Bonding: permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and the capacity to conduct safely any current likely to be imposed on it.
- BB. Basket Cable Tray: A cable support and management system fabricated of continuous, rigid, welded steel wire mesh and available in many sizes with attachment hardware suiting multiple installation methods
- CC. Cable Tray: vertical or horizontal open supports, usually made of aluminum or steel, which are fastened to the building structure. Cables are laid in and fastened to the trays.
- DD. Cabinet: free standing, floor-mounted or wall-mounted modular enclosure designed to house and protect rack-mounted electronic equipment and passive terminations.
- EE. Channel: The end-to-end transmission path between two points at which application specific equipment is connected; encompasses all the elements of the horizontal cabling link, plus the equipment cords in the telecommunications spaces and work area.
- FF. Cross-Connect: equipment used to terminate and tie together communications circuits.
- GG. Cross-Connect Jumper: a cluster of twisted-pair conductors without connectors used to establish a circuit by linking two cross-connect termination points.

- HH. FDE: Fiber distribution enclosure
- II. Grounding: a conducting connection to earth, or to some conducting body that serves in place of earth.
- JJ. Jack: receptacle used in conjunction with a plug to make electrical contact between communications circuits, e.g., eight-position/eight-contact modular jacks.
- KK. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- LL. LAN: Local area network.
- MM. Link: Horizontal cabling link encompassing all components of the horizontal cabling (TO, patch panels, blocks, jumpers, and patch cords that join them in the horizontal cross-connect). It is distinguished from a channel because it does not include the equipment cables/cords at the telecom spaces or work area.
- NN. Media: twisted-pair, and fiber optic cable or cables used to provide signal transmission paths.
- OO. Mounting Frame: rectangular steel framework, which can be equipment rack or wall mounted to support wiring blocks, patch panels, and other communications equipment.
- PP. Outside Plant (OSP): generally, any and all portions of the cable system that runs outside of an environmentally enclosed structure and/or building with each end terminated at different buildings. This specifically includes inter-building cables, conduits, manholes, hand-holes, and innerduct.
- QQ. UTP: Unshielded Twisted Pair.
- RR. FO: Fiber Optic
- SS. Passive Equipment: non-electronic hardware and apparatus, e.g., equipment racks, cable trays, electrical protection, patch panels, wiring blocks, fiber optic shelves, etc.
- TT. Patch Cords: a length of wire or fiber cable with connectors on one or both ends used to join communications circuits at a cross-connect.
- UU. Patch Panel: system of terminal blocks or connectors used with patch cords that facilitate administration of cross-connect fields.
- VV. Pathway: facility for the placement of communications cable. A pathway facility can be composed of several components including conduit, wireway, cable tray, surface raceway, under floor systems, overhead systems, raised floor, ceiling support wires, etc.
- WW. Protectors: electrical protection devices used to limit foreign voltages on metallic communications circuits.
- XX. Raceway: an enclosed channel designed expressly for holding wires or cables; may be of metal or insulating material. The term includes conduit, tubing, wire ways, under floor raceways, overhead raceways, and surface raceways. Raceway does not include cable tray.

- YY. Racks: An open, freestanding, floor-mounted structure, typically made of aluminum or steel, used to mount equipment; usually referred to as an equipment rack.
- ZZ. Riser Backbone: The Riser Backbone subsystem links the main cross connect (MDF) in the equipment room to the distribution rooms (TRs).
- AAA. Telecommunication Outlet (TO): Connecting device mounted in a work area used to terminate horizontal cable and interconnect cabling with station equipment.
- BBB. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- CCC. Work Area Subsystem: The connection between the telecommunications outlet and the station equipment in the work area is provided by the Work Area Subsystem. It consists of cords, adapters, and other transmission electronics.
- DDD. Wireless Access Point (WAP): Telecom outlet designated for use with wireless network devices. Such outlet shall be mounted above ceiling.
- EEE. Contractor – The successful bidder engaged to provide the work of this Specification

1.03 REFERENCES

- A. Most recent revisions, editions, addenda, and bulletins of the following documents:
1. ANSI/TIA 568 series
 2. ANSI/TIA-569 Telecommunications Pathways and Spaces
 3. ANSI/TIA-606 Administration Standard for Telecommunications Infrastructure
 4. ANSI/TIA-607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
 5. ANSI/TIA-862 Structured Cabling Infrastructure Standard for Intelligent Building Systems
 6. TIA-TSB-162 Telecommunications Cabling Guidelines for Wireless Access Points
 7. Telecommunications Distribution Methods Manual
 8. Information Transport Systems Installation Methods Manual (ITSIMM)
- B. California Electrical Code (CEC)
- C. Local Codes and Standards
- D. UL444 – Standard for Safety of Communications Cable
- E. UL 1666 – Standard for Safety of Flame Propagation Height
- F. Local Authority Having Jurisdiction (AHJ)

- G. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either
- H. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense.

1.04 QUALIFICATIONS

- A. The contractor shall hold a valid State of California C7 and C10 Contractor's license.
- B. Contractor shall have a proven track record in the field of specified cabling and system installations, with at least (3) previous installations of comparable size and complexity undertaken within the last (5) years.
- C. Contractor shall be qualified in the installation and termination of copper and fiber cabling as described in this Division.
- D. Contractor shall have BICSI Registered Communication Distribution Designer (RCDD) to sign-off on all designs offered, including stamping the design with their current BICSI/RCDD stamp.
- E. Contractor shall have onsite at least (1) BICSI Registered Installer for copper and fiber (INSTC and INSTF), or (1) BICSI Technician (TECH) on site to perform scope of work.
- F. Contractor shall be a manufacturer's authorized distributor and warrantee station for the equipment offered, and shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment.

1.05 SUBMITTALS

- A. Make submittals in accordance with:
 - 1. Section 00 00 00 – Procurement and Contracting Requirements
 - 2. Section 01 33 00 – Submittal Procedures.
- B. Action Submittals:
 - 1. Shop Drawings
 - i. Owner will provide electronic files in CAD or Revit format, containing the contract document drawing files, for use in the preparing of the shop drawings, by the RCDD.
 - ii. Drawings will be to scale.
 - iii. Submit the following sheets and details:
 - a) Titlesheet and Cover Page: indicate project name and location; include sheet index
 - b) Site Plan

- c) Overall Floor Plans: floor plans showing the locations of devices and cable routing paths with cable types, quantity called out, and device IDs; telecommunications room locations; backbone cable routes; new pathways/conduits/boxes/etc.
- d) Enlarged Plans: Communications rooms with equipment types and quantity called out; coordinated wall elevations with space allocated for trades not covered under Division 27; rack elevations with CFCI and OFCI equipment called out.
- e) Sheets for the entire structured cabling system and grounding and bonding system, identifying such items as PBB, SBB, TBB, rack fills, cabling pathways and pathway fills, ladder and other cable raceways, coordination with other trades, etc.
- f) Rough-in and wiring details.
- g) Topology diagrams, indicating Contractor and Owner scopes of work, as well as interconnecting media (i.e. cross-connections between ISP and Owner's network).

2. Product submittal

- i. Contractor shall furnish products for a complete, turnkey system. Submit major components and ancillary accessories required for complete system. Minor accessories like screws and nuts are not required for submission, unless specified in other Specifications sections.
- ii. Product submittal shall be a single complete submittal. Incomplete submittals will be rejected without review.
- iii. Partial submittals will be allowed for short lead items only with documentation on lead time included at the front of the submittal.
- iv. Catalog cut sheets and data sheets containing physical and dimensional information, performance data, electrical characteristics, materials used in fabrication, material finish, and licenses. Clearly indicate on each sheet what is being submitted on.

3. Qualification Data: Submit at least (3) references for telecommunications cabling jobs already completed, involving both fiber optics and twisted pair cabling, similar in scope to the project described herein. Include, for each customer reference, the following information: Company name, address, phone number, name and email address of contact and type of job completed.

- i. Provide copies of the Contractor's certification.
- ii. Provide written guarantees from manufacturers of major equipment, that a service representative has been assigned.
- iii. Provide copies of technician training certificates.

1.06 CLOSEOUT DOCUMENTS

- A. Final close out documents including, but not limited to, test results on in digital PDF and physical CD-ROM or USB drive, in native tester format, project manual that includes manufacturer and contractor warranties, product cut sheets, material submittals, etc. Also, include the following:
 - 1. Provide "As-Built" Drawings in AutoCAD or Revit.
 - i. "As-Built" drawings indicating location of all equipment including but not limited to work area outlets, patch panels, cross connect blocks, on each segment and cable routing outlet and identifiers. Indicate labeling for each piece of equipment.
 - ii. As-Built drawings will contain all installed cabling and materials. Outlets will be numbered with each cable associated with the work area outlet.
 - iii. Red-lined shop drawings submitted as As-built drawings will be rejected without review.
 - iv. (1) printed, hard copy of final approved as-built drawings in native sheet size will be provided to Owner. Unapproved sheet sizes will be rejected.
 - 2. Place a laminated full-size, minimum "C" sized, floor plan of these drawings (coordinate with Owner) on the wall of each communications room, showing area covered, data locations, and cable label.
 - 3. Provide network schematics when appropriate.
 - 4. Print (2) printed copies of full-sized as-built drawings, and submit to Owner.
 - 5. Provide printed cable test reports in 3-ring binder and submit to Owner.
 - 6. Provide pricing and contact information for emergency service work not covered by warranty.

1.07 QUALITY ASSURANCE

- A. All equipment shall be mounted with Phillips screws, unless specified in other Specification sections.
- B. Standards for Materials and Equipment
 - 1. The Contractor shall provide all materials, equipment, and installation in compliance with the latest applicable standards from ANSI, FCC, ASTM, EIA/TIA, IEEE, CEC, NFPA, NEMA, OSHA, REA, and UL.
- C. Manufacturer's Warranty
 - 1. Contractor shall provide a lifetime warranty on all copper and fiber links and/or channels.
 - 2. Warranty shall meet the following criteria:

- i. A guarantee that the installed cabling system will pass the Commercial Building Telecommunications Standards cited in this document.
 - ii. This warranty will cover all registered links and/or channels.
 - iii. Contractor shall indicate in warranty documentation whether registered links are to be “link” or “channel” type.
 - a) If links are covered, this warranty may be invoked only if the links are comprised entirely of a single manufacturer’s cable and terminations.
 - b) If channels are covered, this warranty may be invoked only if entire channel links are comprised of single manufacturer’s cable, terminations, and patch cords.
 - iv. The Contractor will correct any problems and malfunctions that are warranty–related issues without charge for the entire warranty period. Corrections shall start within 48-hours of notification from Owner.
 - v. If the warranty is needed by the Owner within the warranted period and the original installer is no longer in business, System manufacturer shall find a substitute certified contractor and assume costs to fulfill the obligations of the warranty.
 - vi. Upon acceptance of the warranty paperwork and test results from the Contractor, System manufacturer will mail a notification letter to the installer and a notification letter with warranty certificate to Owner.
 - vii. The warranty period shall commence following the final acceptance of the project by Owner and written confirmation of warranty from System manufacturer.
3. An additional 1-year written warranty covering workmanship and materials from the date of project completion. All repairs shall be made at no cost to the Owner during the warranty period.

D. Testing and Inspection of Communications Equipment

- 1. Provide tests specified below, when applicable or required by Owner, and as indicated under individual items of material, equipment, and work specified in this Specification.
 - i. Furnish all test equipment and instruments required for the tests.
 - ii. Responsible, qualified employees of the contractor in the presence of the Owner or an authorized representative shall perform the cable testing.
 - iii. All individuals involved in the testing phase of the project shall not have been involved in the installation phase nor shall have immediate knowledge of the installation task.

2. End-to-end performance of all parts and channels will be tested.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. To prevent damage, theft, soiling, and misalignment, protect equipment during transit, storage, and handling.
- B. The Contractor shall coordinate the secure storage of equipment and materials on site, or, if no on-site storage is available, shall provide their own secure storage at the Contractor's expense.
 1. Do not store equipment where conditions fall outside the manufacturer's recommendations for environmental conditions.
 2. Do not install damaged equipment. Remove environmental conditions from the site and replace damaged equipment with new equipment.
 3. If off-site storage of materials is necessary, this shall be at the Contractor's expense.

1.09 PROJECT CONDITIONS

- A. Project Environmental Requirements
 1. Hazardous Materials Prohibition
 - i. The Contractor shall ensure that all materials used in the project are asbestos-free, unless specifically authorized in writing by the Owner.
 2. Existing Conditions
 - i. Verify that all conditions on the project site are acceptable for the Work specified in this Section. Prior to bid opening, notify the System Designer, in writing, of any discrepancies, conflicts, or omissions. Otherwise, correct these issues at no additional cost to the Owner.
 - ii. Continue to monitor the project site. If conditions develop that require a variance from the Specifications or Drawings, then immediately notify the Owner in writing. Otherwise, make recommendations, submit drawings showing how the Work may be installed, and, upon approval, proceed with the necessary changes without additional cost to the Owner.
- B. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, and work above ceilings is complete.
- C. Confirmation of Pathway and Cable Manager sizing:
 1. Wherever cabling pathways or managers are installed, it is the Contractor's responsibility to confirm pathway or manager sizing to represent no more than 25% fill upon installation according to manufacturer's fill tables.

2. Pathways deemed overfilled upon installation will not be accepted and shall be remedied at Contractor expense.

1.10 USE OF THE SITE

- A. Where the Owner deems it necessary to place restrictions, use the site as directed by the Owner.
- B. When proceeding with the work, do not interfere with the ordinary use of streets, aisles, passages, exits, or operations of the Owner. During the day, set up cones and barriers in hallways and walkways. Do not string cable down the hallways during normal hours.
- C. Request a hazardous materials worksheet that identifies potentially hazardous locations. Do not proceed with any work in locations where hazardous materials are known to be. Obtain instructions from the Contractor's Project Manager on and when to work in these areas.
- D. Multiple times each day, each contractor shall remove all trash and debris from the site. Before leaving each day:
 1. The Contractor shall replace all ceiling tiles that they have removed.
 2. The Contractor shall place all furniture and equipment that they have moved back into its original location.
 3. The Contractor shall return any equipment that they have disconnected to working order.
 4. The Contractor's Job Foreman shall inspect all work locations to ensure that the rooms are clean and that all of the tasks described above have been done.
 5. It is recommended that the Contractor inspect the site and take pictures to document the condition of the ceilings and walls.

1.11 RESPONSIBILITIES AND COORDINATION

- A. The Contractor shall provide all materials, qualified labor and services required to ensure a complete and operational system, installed in accordance with the intent of the Contract Documents.
- B. The Contractor shall furnish and install all incidental items not actually shown or specified, but which are required by best practices to provide complete functional systems.
- C. The Contractor shall coordinate the details of facility equipment and construction for all specification divisions, which affect the work covered under this Division.
- D. The Contractor shall coordinate all activities with the overall construction schedule.
- E. The Contractor shall coordinate with all other trades. The Contractor will submit a schedule for the installation within 15 days of contract award.

1. The schedule shall include delivery, installation, and testing for conformance to specific job completion dates.
 2. At minimum, the schedule shall provide dates for the start of demolition, the completion of demolition, the installation start date, the completion of copper cabling, the completion of backbone cabling, the completion of testing and labeling, cutover, the completion of the final punch list, final inspection, and acceptance.
- F. The Contractor shall develop a bill of materials, perform material management, and efficiently use the materials whether they are issued by Owner or purchased by the Contractor.
- G. The Contractor shall ensure materials, in excess of, those required to complete the project are kept in their original condition and packaging for restocking.
- H. The Contractor shall maintain a spare set of all major parts for the system at all times.
- I. The Contractor shall maintain existing cables and terminations not determined to be within the demolition scope of work. Cables damaged, removed, or unterminated shall be reinstalled and recertified with the manufacturer's certified installer, and test results provided to the Owner.

1.12 DESIGN CRITERIA

- A. Compliance by the contractor with the provisions of this Specification does not relieve him or she from the responsibilities of providing materials and equipment of proper design, mechanically and electrically suited to meet operating requirements at the specified service conditions.

PART 2 — PRODUCTS

2.01 GENERAL

- A. This Section includes General Requirements for each section in Division 27 and shall be used in conjunction with specifications, other related Divisions and related Contract Documents to establish the total requirements for the project:
1. Refer to specific sections for Product Part Numbers.
- B. All materials and products shall be:
1. Appropriate for the intended use
 2. Permitted by the Authority Having Jurisdiction (AHJ)
- C. All products shall be new, of the latest version at time of bid, and brought to the job site in original manufacturer's packaging. Used equipment and damaged material will be rejected.
- D. Any modifications to equipment to suit the intent of the Specifications shall be performed in accordance with these requirements.

- E. Take care during installation to prevent scratches, dents, chips, etc. Equipment with significant or disfiguring cosmetic flaws will be rejected.
- F. All components will be approved by the System Designer and shall have the most aesthetic value possible while maintaining specified functionality. Hardware shall:
 - 1. Be in compliance with the Construction Documents.
 - 2. Have fit and finish compatible with the existing surrounding structure.
 - 3. Be unobtrusive.
 - 4. Provide the required functionality.
- G. Fabricate custom-made equipment with careful consideration given to aesthetic, technical, and functional aspects of the equipment and its installation.
- H. Provide products that are suitable for the intended use, including, but not limited to environmental, regulatory, and electrical factors.
- I. All fittings, supports, splices, etc. for the system shall be installed to provide a complete assembly- including fasteners, hardware, and other items required to complete the installation as indicated in the Drawings and Specifications.

2.02 SUBSTITUTION POLICY

- A. Substitution requests: Substitution requests will be considered only if submitted to Owner's Representative not less than 7 days prior to project bid date. Acceptance or rejection of proposed substitution is at Owner's Representative's sole discretion. Requests for substitutions shall be considered "not approved" unless approval is issued in writing by Owner's Representative.
- B. Rejection: For equipment, cabling, wiring, materials, and all other products indicated or specified as "no substitutions" or "no alternates", Owner does not expect not desire requests for substitutions or alternate products other than those specified. Owner reserves the right for Owner's Representative to reject proposed substitution requests and submissions of alternates without review or justification.
- C. Contractor shall assume all costs for removal and replacement of any product installed in substitution of those specified. Such costs shall include but not be limited to labor, materials as well as any penalties, fees, or costs incurred for late completion.

PART 3 — EXECUTION

3.01 WORKMANSHIP

- A. Manufactured products, materials, equipment, and components shall be provided, conditioned, applied, installed, connected, and tested in accordance with the manufacturer's guidelines and printed instructions.
- B. The installation of all system components shall be carried out under the direction of qualified personnel. Appearance shall be considered as important as mechanical and electrical efficiency. Workmanship shall meet or exceed industry standards.

3.02 INTENT OF DRAWINGS

- A. The Drawings show only general locations of equipment, devices, raceways, cable trays, boxes, etc., unless specifically dimensioned.
- B. The Contractor shall be responsible for the proper placement and routing of equipment, cable, raceways, cable runway, and related components, according to the Contract Documents and subject to prior review by the Owner and System Designer.
- C. The Contractor shall refer any conflicts within the Contract Documents to the Construction Manager and/or Owner for resolution.

3.03 SERVICE CONTINUITY

- A. Maintain continuity of communications services to all functioning portions of the process or buildings during hours of normal use.
- B. Arrange temporary outages for cutover work with General Contractor. Keep outages to a minimum number and a minimum length of time to minimize operational impact.

3.04 LAYOUT AND TOLERANCES

- A. Follow as closely as practicable the design as shown on the Drawings. Make all necessary measurements in the field to verify exact locations and ensure precise location and fit of specified items. Make no substantial alterations without prior approval of the Owner and the System Designer.

3.05 TESTING AND INSPECTION OF OWNER-PROVIDED EQUIPMENT

- A. Provide tests specified below, when applicable or required by the Owner, and as indicated under individual items of material, equipment, and work specified in this Specification.
 - 1. Furnish all test equipment and instruments required for the tests.
 - 2. Responsible, qualified employees of the contractor in the presence of the Owner or an authorized representative shall perform the cable testing.
 - 3. All individuals involved in the testing phase of the project shall not have been involved in the installation phase nor shall have immediate knowledge of the installation task.

3.06 CONSTRUCTION REVIEW

- A. The System Designer and Owner will review and observe installation work to ensure compliance by the Contractor with Contract Document requirements.
- B. Review, observation, assistance, and actions by the System Designer and Owner shall not be construed as undertaking supervisory control of the work or of methods and means employed by the Contractor. The System Designer's and Owner's review and observation activities shall not relieve the Contractor from the responsibilities of the Contract Documents.

- C. The fact that the System Designer and Owner does not make early discovery of faulty or omitted work shall not bar the Owner from subsequently rejecting this work and withholding payment until the Contractor makes the necessary corrections.
- D. Regardless of when discovery and rejection are made, and regardless of when the Contractor is ordered to correct such work, the Contractor shall have no claim against the System Designer or Owner for an increase in the contract price, or for any payment on account of increased cost, damage, or loss.

3.07 PROJECT RECORD DOCUMENTS

- A. Provide detailed project record documentation for sections listed in Part 1 in addition to the standard requirements, within 30 days after completion of the work.
- B. Maintain separate sets of redlined drawings that show the exact placement and identification of as-built system components. They may be subject to weekly review by the General Contractor or Owner.

3.08 ADDITIONAL CONTRACTOR REQUIREMENTS

- A. Contractor is responsible for the removal and disposal of all installation and construction debris created in the process of the job.
- B. All work areas will be cleaned at the conclusion of the project and no tools or materials shall be left in a manner as to pose a safety hazard.
- C. Projects are not considered finished and will not be paid by Owner until all debris, dust, etc. has been cleaned and removed to the Owner's satisfaction.
- D. Contractor shall remove all abandoned cable per Article 800 of the National Electrical Code and per TIA and BICSI standards, and recycling these materials where possible. Removal of orphaned cable is mandatory.
- E. Contractor shall abide by all Owner Security Policies pertaining to access and conduct while on the Owner's property.
- F. Contractor shall obey all posted speed limits and parking regulations at the Owner's facilities where the work is being performed.
- G. Contractor understands that illegally parked vehicles will be towed, and Contractor is responsible for and will assume all costs associated with towing.

3.09 FINAL ACCEPTANCE

- A. The Contractor is required to notify the System Designer and Owner of a proposed appointment for Final Inspection at least 72 hours before the appointment.
- B. Owner may visit site during construction to ensure installation is in compliance with their requirements. Punch items discovered by Owner shall be resolved within 10 days of discovery.
- C. System acceptance shall be defined as that point in time when the following requirements have been fulfilled:

1. All submittals and documentation have been submitted, reviewed, and approved.
2. The complete system has successfully completed all testing requirements.
3. All punch list items have been corrected and accepted.

END OF SECTION

SECTION 27 05 28

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 — GENERAL

1.01 SUMMARY

A. Contractor Shall Provide and Install

1. The materials and labor required for the installation of cable pathway systems include, but are not limited to:
 - i. Conduits and boxes
 - ii. Non-continuous cable supports
 - iii. Non-metallic cable duct
 - iv. Floor boxes
2. Although such work is not specifically mentioned herein or on the Drawings, the Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, without claim for additional payment.

B. Related Sections:

1. Section 000000 – Procurement and Contracting Requirements
2. Section 010000 – General Requirements
3. Section 260533.13 – Conduit for Electrical Systems, or similar
4. Section 260533.16 – Boxes for Electrical Systems, or similar
5. Section 270000 – Common Work Results for Communications
6. Section 270526 – Grounding and Bonding for Communications Systems
7. Section 271116 – Communications Room Equipment
8. Section 271323 – Backbone Cabling
9. Section 271513 – Horizontal Cabling
10. Section 271619 – Patch Cords
11. Section 274116 – Audiovisual Systems
12. Section 281000 – Access Control and Alarm Management System

1.02 REFERENCES

- A. Design, manufacture, test, and install telecommunications cabling networks per manufacturer's requirements and in accordance with latest revision of the NFPA-70 (the National Electrical Code®), state codes, local codes, requirements of Authorities Having Jurisdiction (AHJs), and the following standards, including the most current revisions, addenda, and any Technical Service Bulletins (TSB's) released at the time of bid, including the most recent editions and addenda of the following documents:
1. ANSI/TIA 568 series
 2. ANSI/TIA-569 Telecommunications Pathways and Spaces
 3. ANSI/TIA-606 Administration Standard for Telecommunications Infrastructure
 4. ANSI/TIA-607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
 5. ANSI/TIA-862 Structured Cabling Infrastructure Standard for Intelligent Building Systems
 6. ASTM B 633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
 7. ASTM A 653 – Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process
 8. ASTM A 510 – Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
 9. ASTM A 641 – Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 10. IEC 61537 (2006) – Cable Tray Systems and Cable Ladder Systems for Cable Management
 11. ASTM D 3363 - 05 Standard Test Method for Film Hardness by Pencil Test
 12. TIA-TSB-162 Telecommunications Cabling Guidelines for Wireless Access Points
 13. Telecommunications Distribution Methods Manual
 14. Information Transport Systems Installation Methods Manual (ITSIMM)
- B. California Electrical Code (CEC)
- C. OSHA Standards and Regulations
- D. Local Codes and Standards
- E. UL 444 – Standard for Safety of Communications Cable
- F. UL 514C – Standard for Safety for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

- G. UL 943 – Ground-Fault Circuit-Interruptioners
- H. UL 1449 – Surge Protective Devices
- I. UL 1666 – Standard for Safety of Flame Propagation Height
- J. UL 1682 – Safety Standard for Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type
- K. Local Authority Having Jurisdiction (AHJ)
- L. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either
- M. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense

1.03 SYSTEM DESCRIPTION

- A. Pathways
 - 1. Pathways are the support system for the infrastructure. All pathways shall conform to the TIA-569-B Commercial Building Standard for Pathways and Spaces. All horizontal and backbone cable shall be properly supported every 48" to 60" inches. Infrastructure Support Systems include, but may not be limited to, the following:
 - i. Conduits, both inside or outside, both above ground or underground, all of which shall be properly supported
 - ii. Non-continuous cable supports, which shall be spaced no more than 60" inches apart
 - iii. Floor boxes for flexible data and audiovisual inputs

PART 2 — PRODUCTS

2.01 CONDUITS AND BOXES

- A. Refer to Division 26 Specifications.

2.02 NON-CONTINUOUS CABLE SUPPORTS

- A. Non-continuous cable supports must:
 - 1. Have a cable-bearing surface on the bottom that is at least equal to the full radius of the cable
 - 2. Maintain complete horizontal and vertical bend radius control of 1 inch
 - 3. Have 90° radius edges to prevent damage while installing cables
 - 4. Be designed so that the mounting hardware is recessed to prevent cable damage

5. Have a removable and reusable hook and loop retainer to contain the cables within the hook
 6. Be factory-assembled for direct attachment to walls, hanger rods, beam flanges, purlins, struts, floor posts, etc. as needed for various on-site conditions
 7. Be manufactured from a non-conductive material suitable for use in air-handling spaces
- B. Provide separate cabling compartments or where additional capacity is needed, multi-tiered non-continuous cable supports shall be used.
- C. Manufacturer:
1. nVent Caddy
 2. Panduit
 3. Or equal

2.03 NON-METALLIC CABLE DUCT

- A. Provide pulling grips.
- B. Duct shall:
1. Fit within nominal conduit trade sizes.
 2. Be halogen-free.
 3. Be resistant to ground chemicals and petroleum products.
 4. Be constructed of PET (Polyethylene Terephthalate) and Nylon 6.
 5. Number of cells: 3x3
- C. Fabric cable duct:
1. Shall:
 - i. Be fabric construction
 2. Manufacturer:
 - i. Maxcell
 - ii. Or equal

2.04 FLOOR BOXES

- A. Shall:
1. Be UL-listed and exceed UL water & crush testing requirements.
 - i. Be rated for outdoor environments

2. Have brass, nickel, or aluminum finish.
 3. Be made for concrete floors.
 4. Have low voltage divider.
 5. Have brass, nickel, or aluminum hinged, lockable protective covers
 6. Have pre-installed ground wire.
 7. Be recessed/flush style.
- B. Manufacturer:
1. Legrand
 2. Leviton
 3. Or equal

PART 3 — EXECUTION

3.01 GENERAL

- A. Provide any necessary screws, anchors, clamps, tie wraps, support hardware, etc. necessary to facilitate the installation of the identification communication system.
- B. Furnish any special installation equipment or tools necessary to properly complete the installation.
- C. Failure to follow the appropriate guidelines may require the installer to provide additional material and labor required to bring the installation back into alignment with the guidelines and to correct, any and all, damage to the cables by the installer during the implementation.
- D. All techniques and fixtures used in the installation must allow for easy maintenance of, and ready access to, all components for test measurements.
- E. No self-tapping screws shall be used.
- F. All parts shall be made of corrosion resistant material, such as plastic, anodized aluminum or brass.
- G. All materials used in installation shall be resistant to fungus growth and moisture deterioration.
- H. All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation.

3.02 NON-CONTINUOUS CABLE SUPPORTS

- A. The use of non-continuous cable supports as a primary pathway is not permitted.
- B. Non-continuous cable supports shall be used to support horizontal cables from the point of their exit from the main pathway (conduit) to the point of termination.
- C. Follow the manufacturer's recommendations for allowable fill capacity for each size of non-continuous cable support.
- D. Installation and configuration of non-continuous cable supports shall conform to the requirements of the ANSI/EIA/TIA Standards 568-C and 569-B, NFPA 70 (National Electrical Code), and applicable local codes.
- E. Non-continuous cable supports shall be placed straight, following building lines on 48" to 60" (1200 mm to 1500 mm) centers.
- F. Non-continuous cable supports shall be installed every 48" to 60", with a maximum sag of 6".
- G. At no point shall cables rest on acoustic ceiling grids or panels.
- H. Cables shall be supported within 12" of any conduit or raceway entrance.
- I. Non-continuous cable supports shall be attached to walls, purlins, beams, threaded-rod, or other components in strict compliance with all manufacturer Instructions and as directed by the Authority Having Jurisdiction (AHJ).

3.03 FLOOR BOXES

- A. Install in accordance with manufacturer's instructions. Test for proper operation. Repair or replace units until satisfactory results are obtained.

END OF SECTION

SECTION 27 05 36

CABLE TRAY

PART 1 — GENERAL

SUMMARY

Contractor Shall Provide and Install

Cable tray

Cable runway

Related Sections:

Section 000000 – Procurement and Contracting Requirements

Section 270500 – Common Work Results for Communications

Section 270526 – Grounding and Bonding for Communications Systems

Section 270528 – Pathways for Communications Systems

REFERENCES

ASTM International:

ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A653/A653M - Standard Specification for Steel Sheet, ZincCoated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A1011 – Specification for Steel, Sheet and Strip, Hot- Rolled, Carbon, Structural, High-Strength Low-Alloy and High Strength Low Alloy with Improved Formability (Formally ASTM A570 & A607)

ASTM A1008 – Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, high-Strength Low-Alloy and high-Strength Low-Alloy with Improved Formability (Formally ASTM A611)

ASTM B633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel

National Electrical Manufacturers Association:

NEMA VE 1- - Metal Cable Tray Systems

NEMA VE 2- - Cable Tray Installation Guidelines

QUALITY ASSURANCE

All cable and equipment shall be installed in a neat and professional manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the owner or owner's representative.

Distributors to supply all equipment and accessories new and free from defects.

Distributors to supply all equipment and accessories in compliance with the applicable standards listed in Part 1 of this section and with all applicable national, state, and local codes.

Distributors to supply all items of a given type shall be the products of the same manufacturer.

Manufacturer to comply with NEMA Standards Publication Number VE1, "Cable Tray Systems".

NEC Compliance: Contractor to comply with NEC, as applicable to construction and installation of cable tray and cable channel systems (Article 392 NEC).

UL Compliance: Manufacturer to provide products that are UL-classified and labeled.

NFPA Compliance: Contractor to comply with NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems

SUBMITTALS

Make submittals in accordance with:

Section 00 00 00 – Procurement and Contracting Requirements

Section 01 33 00 – Submittal Procedures.

Section 27 0500 – Common Work Results for Communications

Action Submittals:

Shop Drawings

Indicate tray type, dimensions, support points, and finishes.

Include accessories such as clamps, brackets, hanger rods, splice plate connectors, expansion join assemblies, and fittings.

Tray routes shall be coordinated with trades prior to submission.

Product submittal

Catalog cut sheets and data sheets containing physical and dimensional information, performance data, electrical characteristics, materials used in fabrication, material finishes, fittings, and accessories. Clearly indicate on each sheet what is being submitted on.

CLOSEOUT DOCUMENTS

As-built documentation of final routing of cable tray and locations of support structures.

PART 2 — PRODUCTS

GENERAL

Except as otherwise indicated, provide metal cable trays, of types, classes and sizes indicated; with splice plates, bolts, nuts, and washers for connecting units. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards.

Material and finish specifications for each tray type are as follows:

Aluminum: Straight section and fitting side rails and rungs shall be extruded from Aluminum Association Alloy 6063. All fabricated parts shall be made from Aluminum Association Alloy 5052.

Pre-galvanized Steel: Straight sections, fitting side rails, rungs, and covers shall be made from steel meeting the minimum mechanical properties and mill galvanized in accordance with ASTM A653 SS, Grade 33, coating designation G90.

Hot-dip Galvanized Steel: Straight section and fitting side rails and rungs shall be made from steel meeting the minimum mechanical properties of ASTM A1011 SS, Grade 33 for 14 gauge and heavier, ASTM A1008, Grade 33, Type 2 for 16 gauge and lighter, and shall be hot-dip galvanized after fabrication in accordance with ASTM A123. All covers and splice plates must also be hot-dip galvanized after fabrication; mill galvanized covers are not acceptable for hot-dipped galvanized cable tray. All hot-dip galvanized after fabrication steel cable trays must be returned to point of manufacture after coating for inspection and removal of all icicles and excess zinc. Failure to do so can cause damage to cables and/or injury to installers.

Stainless Steel: Straight section and fitting side rails and rungs shall be made of AISI Type 304 or Type 316 stainless steel.

Cable tray shall be capable of carrying a uniformly distributed load of 75 lbs. /ft. on a 10-foot support span with a safety factor of 1.5 when supported as a simple span and tested per NEMA VE1 Section 5.2.

CABLE TRAY - BASKET

Manufacturers:

Bason

Manufacturer to provide wire basket cable tray of types and sizes purchased with pre-welded splice bars. Manufacturer to construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the additional construction highlighted in Part 2.

All straight sections shall be constructed with a pre-welded splice plate to connect two runs of wire basket together. These splice bars must be UL approved for grounding with use of grounding clips.

Wire basket cable tray shall be made of high strength steel wires and formed into a standard 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. All mesh sections must have at least one bottom longitudinal wire along entire length of straight section.

Wire basket cable tray sizes shall conform to the following nominal criteria(± 10 mm):

Straight sections shall be furnished in standard 118.3 inch lengths.

Wire diameter shall be a uniform 0.177" (4.5mm), 0.197" (5mm), or 0.236" (6mm) on mesh sections.

Tray sizes shall be as noted on the Drawings.

Tray widths shall be as shown on the Drawings.

In order for a system to be approved as an equipment ground conductor (EGC), all splicing assemblies shall be UL Classified or CSA approved as an EGC. When using powder coated wire mesh cable tray as an EGC, the paint must be completely removed at all contact points of splice/ground bolt attachments.

Material and Finishes: Material and finish specifications for Carbon Steel Wire are as follows.

Electro-Plated Zinc Galvanizing: Straight sections shall be made from steel meeting the minimum mechanical properties of ASTM A510, Grade 1008 and shall be electro-plated zinc in accordance with ASTM B633, Type III, SC-3.

Stainless Steel: Straight sections and accessories shall be made from AISI Type 304 stainless steel meeting the minimum mechanical properties of ASTM A580.

Black Powder Coat: Straight sections shall be powder coated black with an average paint thickness of 1.2mils (30microns) to 3.0mils (75microns).

Hot Dipped Galvanizing: Straight sections shall be made from steel meeting the minimum mechanical properties of ASTM A510, Grade 1008 and shall be hot dipped galvanized after fabrication in accordance with ASTM A123.

All fittings shall be field formed from straight sections in accordance with manufacturer's instructions.

Wire basket cable tray supports shall be trapeze hangers or wall brackets.

CABLE TRAY ACCESSORIES

All fittings must have a minimum radius of 12 inches.

Splice plates - shall be the bolted type made as indicated below for each tray type. The resistance of fixed splice connections between adjacent sections of tray shall not exceed .00033 ohms. Splice plate construction shall be such that a splice may be located anywhere within the support span without diminishing rated loading capacity of the cable tray.

Aluminum Tray - Splice plates shall be made of 6063-T6 aluminum, using ribbed neck spline bolts and serrated flange locknuts. Hardware shall be zinc plated in accordance with ASTM B633, SC1.

Steel (including Pre-galvanized and Hot-dip galvanized) - Splice plates shall be manufactured of high strength steel, meeting the minimum mechanical properties of ASTM A1011 Grade 33. Each splice plate shall be attached with ribbed neck spline bolts and serrated flange locknuts. Hardware shall be zinc plated in accordance with ASTM B633 SC1 for pre-galvanized and hot-dip galvanized cable trays unless otherwise noted.

Splice plates shall be furnished with straight sections and fittings.

Cable Tray Supports - Shall be placed in a quarter span configuration, and so that the support spans do not exceed maximum span as indicated in NEMA VE-2. Supports shall be constructed from 12 gauge steel formed shape channel members 1-5/8 inch by 1-5/8 inch with necessary hardware.

Trapeze hangers and center-hung supports shall be supported by 3/8 inch (minimum) diameter rods.

Barrier Strips - Shall be placed as specified on drawings and be fastened into the tray with self-drilling screws or U-bolts with acorn nuts.

Cable Tray Hold Downs – Cable tray supported on standard 1-5/8 inch strut shall be held down with US Tray style hold-down brackets.

Cable Cleats shall be provided.

Accessories - special accessories shall be furnished as required to protect, support, and install a cable tray system. Accessories shall consist of, but are not limited to: section splice plates, expansion plates, blind-end plates, specially designed ladder dropouts, barriers, and hold down clips

CABLE RUNWAY

Manufacturer: RXL

1050-BK12

Cable runway system shall be a modular system of ladder, turns, splices, supports, and accessories able to be assembled with couplers.

Powder coat paint in black.

Cable runway shall be nominally sized 12" width.

Provide and install the following components and additional accessories as necessary for a complete system:

Overhead mounting equipment (thread-rod, unistrut, nuts, washers, etc.) suitable for the supporting structural elements

Ladder rack section couplers (splices)

Ladder rack radius bends

Ground strap kits

Splice kits

End protectors

Vertical and horizontal turns

Corner brackets

Triangular support brackets

PART 3 — EXECUTION

GENERAL

Contractor or approved sub-contractor to remove exposed abandoned cable tray, including abandoned cable tray above accessible ceiling finishes. Remove supports. Cut wire basket cable tray flush with walls and floors, and patch surfaces.

INSTALLATION

Cable tray shall be used in horizontal applications. Ladder rack is used in vertical applications.

Cable tray and ladder rack sections shall be bonded together with bonding conductors and the system bonded to the bonding busbar in the space. Abide by manufacturer's specifications.

Install cable trays as indicated: Installation shall be in accordance with equipment manufacturer's instructions, and with recognized industry practices to ensure that cable tray equipment comply with requirements of NEC and applicable portions of NFPA 70B. Reference NEMA-VE2 for general cable tray installation guidelines.

Coordinate cable tray with other electrical work as necessary to properly integrate installation of cable tray work with other work.

Provide sufficient space encompassing cable trays to permit access for installing and maintaining cables.

Cable tray fitting supports shall be located such that they meet the strength requirements of straight sections. Install fitting supports per NEMA VE-2 guidelines, or in accordance with manufacturer's instructions.

In order for a system to be approved as an equipment ground conductor (EGC), all splicing assemblies shall be UL Classified or CSA approved as an EGC. For adjustable splices and expansion areas, copper bonding jumpers must be used when using the system as an EGC.

Support trays and fasten to structure. Install supports at each connection point, at end of each run, and at other points to maintain spacing between supports of 5 feet (150 cm) maximum. Use manufacturer recommended size for cantilever brackets. Installation of oversized or undersized cantilever brackets may lead to system failure.

Cable tray shall not be center hung.

Cable tray shall be free of burrs and sharp edges. Polish off edges, so that the cable tray is smooth.

Divided cable runs shall be kept separate with a solid barrier.

1.01 CABLE RUNWAY INSTALLATION

- A. Install with side stringers facing down so the runway forms an inverted U-shape and that the hardware between the stringers and cross members face away from cables.
- B. Secure to the structural ceiling, building truss system, wall, floor or tops of equipment racks and/or cabinets using the manufacturer's recommended supports and appropriate hardware, as defined by local code or the authority having jurisdiction (AHJ).
 - 1. Secure to each support with included hardware with a minimum of two fasteners.
 - 2. Support requirements:
 - a) 5 feet (1.5 m) or less in accordance with TIA-569-B.
 - 1) Splices: Within 2 feet (0.6 m)

- 2) Intersections: Within 2 feet (0.6 m) on all sides of every intersection.
 - 3) Changes in Elevation: Within 2 feet (0.6 m) on both sides.
 - 4) Attached vertically to wall: 2 feet (0.6 m).
3. Splices: Place mid-span, not over a support, with the manufacturer's recommended splice hardware.
4. Overhead installation clearances:
 - a) Above runway: 12 inches (300 mm) minimum.
 - 1) From building or ceiling structure: 12 inches (300 mm) minimum.
 - 2) Between runway and the top of equipment racks and/or cabinets: 3 inches (75 mm).
 - 3) Multiple runway tiers: 12 inches (300 mm) minimum.
 - 4) Above acoustical ceilings: 3 inches (75 mm).
5. Cable fill tolerances:
 - a) Maximum: 6 inches (150 mm) high.
 - 1) Over 2-inch (50 mm) outside diameter or non-secured cables: Install 8-inch (200 mm) high cable retaining posts or 6-inch (150 mm) high pathway dividers.
 - b) Quantity of cables:
 - 1) Not to exceed a whole number value equal to 50 percent of the interior area of the cable runway, divided by the cross-sectional area of the cable. The interior area of cable runway will be considered to be the width of the cable runway multiplied by a height of 2 inches (50 mm), unless cable retaining posts/pathway dividers are added to the runway. The interior area of cable runway equipped with cable retaining posts/pathway dividers will be considered to be the width of the cable runway multiplied by a height of 6 inch (150 mm). Actual cable fill for cable runway that is not equipped with cable retaining posts/pathway dividers will not exceed 2 inches (50 mm) in height. Actual cable fill for cable runway equipped with cable retaining posts/pathway dividers will not exceed 6 inch (150 mm) in height.
 - c) Weight of cables:

- 1) Not to exceed the stated load capacity of the cable runway as stated in the manufacturer's product specifications or design tables.
6. Secure cables (cable bundles) to the cross members with reusable straps.
7. Cover the exposed ends of the cable runway that do not terminate against a wall, the floor, or the ceiling with fire-retardant black colored end caps made from a rubberized material or an end closing kit consisting of a flat bar of cable runway stringer material factory cut to the width of the cable runway and secured to the cable runway with a junction splice kit.
8. Separate different cable media types within the cable runway using pathway dividers. Treat each type of cable media separately when determining cable fill limits.
9. Where cable exits or enters the end, middle or side of overhead cable runway to access a rack, frame, cabinet or wall-mounted rack, cabinet or termination field, a radius drop shall be used to guide the cable.
10. Maintain a minimum separation of 2 feet (0.6 m) between cable runway used for communications cables and pathways for other utilities or building services.
11. Touch-up paint color-matched to the finish on the component and will correct any minor cosmetic damage (chips, small scratches, etc.) resulting from normal handling during the installation process prior to delivery to the owner. If a component is cosmetically damaged to the extent that correction in the field is obvious against the factory finish, the component will be replaced with a new component finished from the factory. If a component is physically damaged due to mishandling or modification during the installation process, it shall not be used as part of the cable runway system.

1.02 TESTING

- A. Test cable trays to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. See NFPA 70B for testing and test methods.
- B. Manufacturer shall provide test reports witnessed by an independent testing laboratory of the "worst case" loading conditions outlined in this specification and performed in accordance with the latest revision of NEMA VE-1; including test reports verifying rung load capacity in accordance with NEMA VE-1, Section 5.4.

END OF SECTION

SECTION 27 05 53

IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 — GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. The supply, delivery, supervision, coordination, and installation of equipment items specified herein and shown on the Drawings.
 - 2. The documentation and instruction for completing the Identification for Communication Systems.
- B. Related Sections:
 - 1. Section 000000 – Procurement and Contracting Requirements
 - 2. Section 010000 – General Requirements
 - 3. Section 260526 – Grounding and Bonding for Electrical System
 - 4. Section 270526 – Grounding and Bonding for Communications Systems
 - 5. Section 270528 – Pathways for Communications Systems
 - 6. Section 271116 – Communications Room Equipment
 - 7. Section 271513 – Horizontal Cabling
 - 8. Section 271619 – Patch Cords
 - 9. Section 271700 – Testing of Structured Cabling Systems

1.02 SYSTEM DESCRIPTION

- A. The Contractor will provide and install identification labeling for the project's communications systems, including all components from the TR to the work outlet and between telecommunications spaces.
- B. Identification
 - 1. In addition to the general requirements above, the Contractor shall submit the following additional data:
 - i. Cable identification numbers scheme for all installed items.
 - ii. Cable identification matrix

PART 2 — PRODUCTS

2.01 LABELING

- A. Labels shall be compliant with Owner's labeling standards.

- B. Handwritten labels will be rejected.
- C. Comply with TIA-606 and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- D. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.
- E. Label shall be black typeface on white tape.
- F. Manufacturer:
 - 1. Brother PT-D400
 - 2. Or equal

2.02 COMMUNICATIONS ROOM EQUIPMENT

- A. Refer to Owner's labeling standards.
- B. Label components where they are administrated (i.e. punch down points, panels, wall blocks, faceplates, etc.)
- C. Fiber enclosures shall clearly indicate type of fiber cable terminated: singlemode or multimode.

2.03 CABINET LABELING

- A. Refer to Owner's labeling standards.

2.04 CABLE LABELS

- A. Refer to Owner's labeling standards.
- B. Cables labels are identified with information that defines the connection between the near end panel connection and the far end panel connection.
- C. Label cables within 3" from termination on both ends of cable. Label shall match faceplate label.
- D. Label fiber cables 12" from where cable enters enclosure with a label that identifies the cable's origin and destination.
 - 1. Label corresponding fiber strand pairs.
 - 2. Labels shall note the strand's color, origin, and destination. Origin and destination shall include room name.
- E. The near end connection is the connection that is closest to the Main Distribution Area (MDA) in the network topology. A near end connection identifier would consist of the cabinet/rack location, panel location, and port location.

- F. The far end connection identifier would consist of the cabinet/rack location, panel location, and port location.
- G. A typical cable label would have information in the following scheme:
- H. This identifier would be decoded to define the cable connects between cabinet AB04 panel 24 port 01 going to cabinet AB07 panel 36 port 13. The far end of the cable would have a label that would have the same information.

2.05 PATCH CORD/EQUIPMENT CORD LABELS

- A. Refer to Owner's labeling standards.
- B. Refer to 27 16 19 for additional requirements.
- C. Patch cord/equipment cord labels are identified with information that defines the connection between the near end patch panel front connections and the far end patch panel front connections or equipment connections.
- D. A near end connection identifier would consist of the cabinet/rack location, panel location, and port location.
- E. The far end connection identifier would consist of the cabinet/rack location, panel location, and port location.

PART 3 — EXECUTION

3.01 GENERAL

- A. Provide any necessary screws, anchors, clamps, tie wraps, support hardware, etc. necessary to facilitate the installation of the identification communication system.
- B. Furnish any special installation equipment or tools necessary to properly complete the installation.
- C. Failure to follow the appropriate guidelines may require the installer to provide additional material and labor required to bring the installation back into alignment with the guidelines and to correct, any and all, damage to the cables by the installer during the implementation.
- D. All techniques and fixtures used in the installation must allow for easy maintenance of, and ready access to, all components for test measurements.
- E. No self-tapping screws shall be used.
- F. All parts shall be made of corrosion resistant material, such as plastic, anodized aluminum or brass.
- G. All materials used in installation shall be resistant to fungus growth and moisture deterioration.

3.02 SYSTEM ADMINISTRATION

- A. All components of the installed system shall be uniquely identified by location, function, unit, and sub-unit.
- B. Each location shall be identified by a unique alphanumeric identifier.
- C. Each equipment enclosure in the building shall be assigned a unique alphanumeric identifier.
- D. Each adapter module installed in each distribution or interconnect enclosure shall be identified by an alphanumeric identifier.
- E. All conduits, trays, and pathways shall be identified by a unique alphanumeric identifier.
- F. Optical fiber cables shall be identified by a textual label, which indicates its type, strand count, point of origin, and termination.
- G. Supply all records in compliance with ANSI/TIA 606.
- H. Provide a database, compliant with Open Database Connectivity (ODBC), for administration of the Structured Cabling System described herein.

3.03 IDENTIFICATION

- A. Prior to the installation or termination of cabling, confirm all specific labeling requirements with the Owner or the Owner's Engineer.
- B. Cables
 - 1. Mark backbone cables at each endpoint and at all intermediate pull points, access points, and junction boxes. Labels shall indicate the origination and destination identifier, the sheath identifier, and the strand or pair range.
 - 2. Horizontal cables shall be marked at each end, on the sheath indicating the TR, patch panel and panel port to which the cable is wired.
 - 3. Faceplates, Patch Panels, and Wiring Blocks
 - 4. Mark Fiber Distribution Enclosures (FDEs) with adhesive labels that indicate the range of circuits installed within. Label each port with the origination and destination grid identifier and the individual strand ID.
 - 5. Label patch panels alphabetically or numerically. Individual ports shall come from the factory pre-labeled with a general number designation.
 - 6. Label each faceplate to indicate, for each cable that it houses, the TR, patch panel, and panel port to which the cable is wired.
 - 7. Label each wiring block numerically, beginning at the top left of the termination field. Within each block, identify the individual rows alphabetically, beginning at the top left and proceeding sequentially down and to the right. Label each row with the corresponding cable identifier and label each pair or circuit on each cable.

8. Fit each cable with a self-laminating label, bearing the appropriate cable identifier, that surrounds the outermost jacket. Place the label at each end of the cable, within 3 inches (75 mm) of the end of the sheath.
9. Fit each equipment enclosure with a self-adhesive label bearing its respective identifier, affixed to the top center of the front and rear doors.
10. Fit each FDE with a self-adhesive label, bearing its respective identifier in block characters, affixed at the top center of the front and rear faces.
11. Fit each adapter inside enclosures with a label bearing its identifier, affixed directly adjacent to its shortest side. Rotate characters so that their orientation is kept left to right, top to bottom.
12. Label conduits and pathways within 0.5 m (18 inches) of each end, where exposed and accessible. It is recommended that additional labeling be provided every 3 m (10 feet) of exposed length.
13. Fit network equipment with a label, placed in an accessible area on the front and rear, bearing the appropriate identifier, MAC address, and date of installation. The label shall not interfere with the operation of or interface to the unit, nor shall it obscure manufacturer's labels.

END OF SECTION

SECTION 27 11 16

COMMUNICATIONS ROOM EQUIPMENT

PART 1 — GENERAL

SUMMARY

- A. Contractor Shall Provide and Install

The Contractor shall furnish and install telecommunications passive equipment, including:

Cabinets

Patch Panels

Cable Management

Uninterruptible Power Supplies

Fiber Enclosures

- B. Although such work is not specifically mentioned herein or on the Drawings, the Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, without claim for additional payment.
- C. The Contractor shall provide system demonstration, system documentation, and instruction of Owner personnel, without claim for additional payment.
- D. Related Sections:

Section 000000 – Procurement and Contracting Requirements

Section 000000 – Procurement and Contracting Requirements –

Section 010000 – General Requirements

Section 260526 – Grounding and Bonding for Electrical Systems

Section 270500 – Common Work Results for Communications

Section 270526 – Grounding and Bonding for Communications Systems

Section 270553 – Identification for Communications Systems

Section 271323 – Backbone Cabling

Section 271513 – Horizontal Cabling

Section 271116 – Patch Cords

SYSTEM DESCRIPTION

- A. This document describes the products and execution requirements relating to furnishing and installing Communications Equipment Room FITTINGS.

PART 2 — PRODUCTS

CABINETS

- A. Cabinets shall be used to provide a neat and efficient means for routing and protecting cables, patch cords and power cables in cabinets for server applications.
- B. Cabinets shall have provisions for routing cables from overhead, and shall accept horizontal cable managers, and cable management accessories used throughout the cabling system.
- C. Cabinets and accessories shall be provided to support Owner's requirements.
- D. Provide mounting accessories.
- E. Cabinets shall have the following attributes:

Black powder coated and constructed of steel

Adjustable front and rear cage nut equipment rails with rail position markers

Rack unit markers

Minimum 44 Rack units

Single point bonding at top and bottom of cabinet

Floor mount brackets

19" loading width

84"H x 24"W x 28.5"

- F. Manufacturer: RXL

RXL-5550

HORIZONTAL CABLE MANAGEMENT

- A. Horizontal cable management devices will provide containment and concealment of interconnect or equipment cordage in an enclosure or rack, guide patch and equipment cords between the vertical cable manager and individual connections and allow access for cables without blocking the jacks
- B. The horizontal cable manager will be of an appropriate size to accommodate cabling requirements. A single horizontal cable manager may be used to support multiple patch panels, if it can accommodate cable fill requirements.
- C. The horizontal cable manager shall:

Be manufactured of composite materials

Have a color that matches the rack or enclosure

Provide 1 RU of horizontal cable management for every RU of connectivity

Match the rack-mount width of the racks, frames, or cabinets that it serves

Attach to the front or rear of the equipment mounting rail with screws and will be of a size that fits within standard EIA 310 spacing

Fitted with a removable cover, hinged to open up or down, that will snap on to secure the cover in the closed position

Have bend-limiting slots or holes at the rear to facilitate front-to-rear cabling through the horizontal manager

Have bend-radius-controlling T-shaped or L-shaped cable guides, along the top and bottom surfaces

Have evenly-spaced cable openings, with rounded edges to protect cables, between the cable guides to allow cables to enter and exit the cable manager in a neat and orderly fashion

D. Manufacturer: Leviton

1RU front & rear w/ cover: 491RU-HFR

1RU front only w/ cover: 491RU-HFO

2RU front & rear w/ cover: 492RU-HFR

2RU front only w/ cover: 492RU-HFO

1RU blank panel: 49254-BP1

VERTICAL CABLE MANAGERS

A. Vertical cable managers shall:

Be double-sided H-shaped trough with a front door and a rear door.

Front and rear sides of the cable manager have T-shaped cable guides separated by openings that align with each U space on the rack.

Middle of the manager shall have a vertical support member with an integrated vertical track that shall allow quick attachment and vertical adjustment of cable management accessories inside the manager.

Center of the manager will also have openings along both sides of the support to allow easy cable pass-through.

Have doors be supported from the tops and bottoms of the cable manager be opened and secured in the closed position with a single lever/latch.

Width: 6 inches (150 mm)

Depth: 15.5 inches (394 mm)

Height: 72 inches (1.8 m)

Finishes and colors: Powder coat paint in black. T-shaped cable guides are black.

B. Accessories:

Half Spool Kit.

Rotating Management Finger Kit.

Cable Bundle Swivel Kit.

Dual PDU Bracket.

Solid Side Panel.

Solid Mid Panel for Double-Sided Vision.

C. Manufacturer: Leviton

8980L-VFR

4980L-VFR

MODULAR PATCH PANELS

A. Patch panels for modular field termination of Category 6 or 6A Unshielded Twisted Pair (UTP) cable shall:

Be angled modular components with a capacity of 48 connections

Made of a steel frame with black powder coat finish

Have space on the front for labeling and identification

Accept a variety of media and connectivity components, including UTP, optical fiber, and audio/visual components

Be made by an ISO 9001 Certified Manufacturer

B. Manufacturer: Leviton

2RU 48-port, angled: 49256-H48

Rear cable management bar: 49006-AMB

FIBER DISTRIBUTION ENCLOSURES

A. Fiber distribution enclosures shall:

Be 1, 2, or 4RU.

Accept a variety of adapter plates, plug-and-play modules.

Have sliding trays.

Manufacturer: Leviton

- a) 1RU: 5R1UH-S03
- b) 2RU: 5R2UH-S06
- c) 4RU: 5R4UH-12

UNINTERRUPTIBLE POWER SUPPLY

- A. Provide (1) per rack or cabinet
- B. UPS will provide temporary power in the event of a power outage until emergency is activated or main building power is restored.
- C. UPS will be sized to accommodate power loads of the systems it serves with an 8-hour runtime.
- D. Accessories will be provided for installation.
- E. UPS shall:

Be rack-mounted

Be viewable and configurable via web management software

Be minimum 3kA.

Have 3-year warranty.

Sized for 5 mins of runtime

- F. Manufacturer: Xtreme Power Conversion

POWER DISTRIBUTION UNIT

- A. Provide (1) per rack or cabinet
- B. Power distribution unit shall:

Be unmetered 120V, 20A

Have a minimum of (10) 5-20R receptacles

Have circuit breaker protection

Have LED indicators

Be rack mounted

Manufacturer: Xtreme Power Conversion

PART 3 — EXECUTION

CABINETS

- A. Provide all components of the cabinet system (cabinet, front and rear doors, side panels, mounting rails, cable managers, power strips, and accessories) as specified elsewhere in this Section and other referenced sections.
- B. Position the cabinet so that the front and rear doors and the cabinet body (as applicable) can be fully opened without being obstructed by other building, storage, or architectural components.
- C. Follow the manufacturer's installation instructions when securing the cabinet to the floor, wall, and backboard.
- D. On floor-supported cabinets, the wheeled base must contact the floor. The wheeled base should not be removed or omitted from the installation.
- E. If the cabinet is not attached to the wall, then the floor, shelf, or tabletop surface on which the cabinet is placed must be able to support the combined weight of the cabinet and the equipment it houses.
- F. Do not attach the cabinet to gypsum wall board. The cabinet must be attached directly into studs through a ¾ inch (19 mm) plywood backboard. The cabinet may be attached to a masonry wall if the installer provides the hardware. Use included hardware, or the appropriate hardware as defined by local code or the authority having jurisdiction. When installed, the top of the cabinet should be no more than 2.1 m (84 inches) above the finished floor.
- G. Cables shall enter and exit the cabinet through conduit knockouts in the top and/or bottom of the cabinet. When cables pass through a conduit knockout but are not enclosed in conduit, use edge-protection grommets on conduit knockouts.
- H. Before installing equipment in the cabinet:

Install and adjust the position of all accessories, including vertical cable managers, power strips, equipment-mounting rails, fan kits, lights, etc.

Verify that fans, lights, and power strips work prior.

- I. If shelves are used, they may be installed with the equipment.
- J. Evenly and uniformly distribute the equipment load within cabinet enclosures. Place large and heavy equipment towards the bottom of the cabinet enclosure. Secure all equipment to the rack with equipment mounting screws.
- K. Provide a telecommunications bond for equipment in the cabinet.
- L. Attach a vertical busbar to the equipment mounting rails to provide electrical continuity from the equipment to the SBB or Mesh-BN through the enclosure.
- M. The ground shall meet TIA 607-C, local code requirements and shall be approved by the Authority Having Jurisdiction (AHJ).
- N. For additional Grounding and Bonding instructions, refer to Section 270526.

PATCH PANELS

- A. Install patch panels in the equipment racks/cabinets as identified by the Owner. Locate fiber patch panels at the top of the rack/cabinet.
- B. Install patch panels square and plumb and fasten them to the mounting rails in four places using manufacturer-supplied screws, with at least one fastener at each corner.
- C. Install CAT6 patch panels under fiber patch panels, but above CAT6A patch panels. CAT6A patch panels shall be installed after CAT6 patch panels have been installed.
- D. Install horizontal cable support bars at the rear of all patch panels as indicated on the manufacturer's instructions.
- E. Attach all accessories supplied with the panels per the manufacturer's instructions.
- F. Fully load copper patch panels with jacks.
- G. Restore all covers, panels, label holders, and accessories removed during the installation of panels to their original places and states.
- H. On the front and rear of each patch panel, place a machine-generated, self-adhesive white label bearing the panel's identifier, as listed in the submittals, in black ½ inch block letters.

HORIZONTAL CABLE MANAGEMENT

- A. Place and install all horizontal and vertical wire and cable management devices and assemblies so as not to impede the efficient use of or connection to adjacent panels, enclosures, or equipment.
- B. Upon completion of the task, replace all covers, doors, and panels that were removed during the installation.
- C. Horizontal Cable Managers

When more than one horizontal cable manager is used on a rack, frame, or cabinet, or on a group of racks, frames, or cabinets, use the same make and style cable manager.

The color of the cable managers must match the color of the racks or frames.

Attach horizontal cable managers to the rack, frame, or cabinet with four screws according to the manufacturer's installation instructions. Each cable manager should be centered in the allocated rack-mount space.

Place horizontal managers so that the number of ports (cables) they support will not exceed the cable fill capacity of the cable managers.

After cabling is complete, attach the covers to the cable managers in the closed position.

Install equipment rack horizontal cable and wire management panels directly adjacent to (above and below) all distribution enclosures, patch panels, and termination hardware in the rack as depicted in the appropriate project Drawings.

WIRING PRACTICES

- A. Where specific instructions are not given, perform all wiring in strict adherence to standard industry practices as described in the referenced Telecommunications Distribution Methods Manual (TDMM), and ANSI/TIA-568 standards.
- B. All cables shall originate and terminate at active or passive devices. Cables shall not be spliced. Where several devices are in close proximity, use approved housing to housing connectors and adapters.
- C. All cables terminated in a connection plate mounted in an enclosure shall be dressed to allow cables to be removed from the enclosure and shall be of sufficient cable length to allow for service or re-termination. The plate shall either set on the floor or freely swing clear.

IDENTIFICATION

- A. Uniquely identify all components of the installed system by location, function, unit, and sub-unit.
- B. Identify each location with a unique alphanumeric identifier.
- C. Assign a unique alphanumeric identifier for each equipment enclosure in the building.
- D. Identify each adapter module in each distribution or interconnect enclosure with an alphanumeric identifier.
- E. Identify optical fiber cables by a textual label that indicates its type, strand count, point of origin, and termination.
- F. Supply all records in compliance with ANSI/TIA 606.

END OF SECTION

SECTION 27 13 23

BACKBONE CABLING

PART 1 — GENERAL

1.01 SUMMARY

- A. Contractor Shall Provide and Install
 - 1. The Contractor shall furnish and install telecommunications passive equipment, including:
 - i. Backbone fiber optic cable
- B. Related Sections:
 - 1. Section 000000 – Procurement and Contracting Requirements
 - 2. Section 010000 – General Requirements
 - 3. Section 270000 – Common Work Results for Communications
 - 4. Section 270526 – Grounding and Bonding for Communications Systems
 - 5. Section 270528 – Pathways for Communications Systems
 - 6. Section 270553 – Identification for Communications Systems
 - 7. Section 271619 – Patch Cords
 - 8. Section 271700 – Testing of Structured Cabling Systems

1.02 SYSTEM DESCRIPTION

- A. The Contractor will provide, install, and test a complete structured cabling system for the project's voice and data communications systems in between the Telecommunications Room (TR). The Contractor will provide and install all required components as identified below.
 - 1. Fiber optic backbone cabling includes backbone cable, connectors in the Technology rooms or adjacent to active equipment, and patch cords or jumpers.

PART 2 — PRODUCTS

2.01 OPTICAL FIBER CABLE PERFORMANCE

- A. Shall comply with Owner's standards.
- B. Where not included in standards, Contractor shall provide as specified below.
- C. Optical Fiber Strands
 - 1. All optical fibers shall:

- i. Be usable and shall meet required specifications.
- ii. Be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification.
- iii. Consist of a doped silica core surrounded by a concentric glass.
- iv. Be proof tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m²).
- v. Be coated with a dual layer acrylate protective coating that is in physical contact with the cladding surface.
- vi. Have a maximum attenuation value for each cabled fiber at 23°C ± 5°C on the original shipping reel.

D. Singlemode (8.5/125 µm)

- 1. Unshifted Single-Mode Optical Fibers with Low Water Peak,” and ITU recommendation TG.652, “Characteristics of Single-Mode Optical Fiber Cable.” The fibers shall have:
 - i. A core/cladding diameter (characterized) of 8.2 µm/125.0 µm ± 0.7 µm.
 - ii. Core-to-cladding concentricity of no more than 0.5 µm.
 - iii. Cladding non-circularity of no more than 1.0%.
 - iv. A coating diameter of 250 µm, plus optional 900 µm buffer.
 - v. Attenuation of 0.34 dB/km at 1310 nm and 0.22 dB/km at 1550 nm.
 - vi. Attenuation uniformity with no point discontinuity greater than 0.05 dB at either 1310 nm or 1550 nm.
 - vii. Water peak attenuation at 1383 nm ± 3 nm that is no more than 0.31 dB/km.
 - viii. A cabled cutoff wavelength: (λ_{ccf}) that is no more than 1260 nm.
 - ix. IEEE 802.3ae performance that supports laser-based Gigabit Ethernet (GbE) operation in the 10GBASE-LR (1300 nm) operating window at 10,000 m.
 - x. A mode field diameter of 9.20 µm ± 0.40 µm at 1310 nm and 10.4 µm ± 0.8 µm at 1550 nm.
 - xi. Macrobend attenuation due to 100 turns of fiber around a 50 mm ± 2 mm diameter mandrel that does not exceed 0.05 dB at 1310 nm and 1550 nm.

- xii. A zero dispersion wavelength (λ_0) of 1301.5 nm that is not more than λ_0 at 1321.5 nm or less.
- xiii. A zero dispersion slope (S_0) of no more than 0.086 ps/(nm•km).
- xiv. Maximum dispersion of no more than 3.2 ps/(nm•km) from 1285 nm through 1330 nm and less than 18 ps/(nm•km) at 1550 nm.
- xv. A fiber curl with a curvature radius of no less than 4.0 m.

E. Fiber Optic Cable Fire Ratings

- 1. Listed optical fiber backbone cable is acceptable for use on this project.

F. Fiber Optic Cable Termination

- 1. Where cables are installed, the 900 μ m buffer, 250 μ m coated fibers or ribbonized fibers contained in these cables may be terminated either by:
 - i. Fusion splicing of factory-polished splice-on connectors or factory-terminated cable assemblies ("pigtailed").
 - ii. Cam-style mechanical splice connectors using a tool that provides calculated insertion loss at the point of termination
 - iii. Individual fibers secured in a protective covering, such as an aramid-reinforced tube with connectors mated to the resulting assembly

G. Fiber Optic Cable Features

- 1. The size and configuration of fiber optic cables shall be as shown on the Drawings.
- 2. The buffered fibers shall be grouped in subunits of 6 or 12 fibers.
 - i. Subunits shall be stranded around a dielectric central member.
 - ii. Layered aramid yarns shall serve as the tensile strength member of the subunit.
 - iii. To facilitate jacket removal, a ripcord may be applied between the aramid yarns and the subunit jacket.
 - iv. For physical and environmental protection, the subunit jacket shall be extruded over the aramid yarns.
 - v. The jacket shall be continuous and free from pinholes, splits, blisters, or other imperfections have a consistent, uniform thickness and be smooth, as is consistent with the best commercial practice
 - vi. The subunits shall be stranded around a dielectric central member, a ripcord shall be inserted beneath the outer jacket to facilitate jacket removal, an outer jacket shall be extruded around the subunits.

3. An overall helically wound interlocking metallic armor shall be provided, to surround the outer cable jacket, to which a listed outer jacket shall be applied.
4. The individual fibers shall be color-coded for identification and shall meet these requirements:
 - i. The optical fiber color coding shall be in accordance with TIA-598-C, "Optical Fiber Cable Color-Coding."
 - ii. The coloring material shall be stable over the temperature range of the cable, shall not be susceptible to migration, and shall not affect the transmission characteristics of the optical fibers.
 - iii. Color-coded buffered fibers shall not adhere to one another.
5. The overall jacket for graded index cables as specified herein shall be aqua for distribution cables, or black for indoor-outdoor rated cables.
6. The overall jacket for single-mode cables as specified herein shall be yellow for distribution cables, or black for indoor-outdoor rated cables.

2.02 BACKBONE FIBER OPTIC CABLE

- A. Refer to drawings for required cable and strand counts.
- B. Indoor/Outdoor Singlemode OS2
 1. Color: Yellow
 2. Plenum rated, Armored
 3. Water-blocking and UV-resistant
 4. Manufacturer:
 - i. Leviton #PDPK012-I/O-C4C5(YEL)-AB0707
- C. Accessories
 1. LC shuttered molded splice modules
 - i. OS2 duplex: SPLCS-2LL
 - ii. OS2 quad: SPLCS-4LL
 - iii. OS2 duplex: SF100-S2L
 - iv. OM4 quad: SF100-S2M
 - v. OS2 quad: SF100-S4L
 - vi. OM4 quad: SF100-S4Q

2. LC Fusion splice connectors
 - i. Green: 499LC-GN9
 - ii. Blue: 499LC-BL9
3. Pre-policed LC connectors
 - i. Multimode: 49991-LLC
 - ii. Singlemode: 49991-SLC
4. Pigtails and fanout kits
 - i. Singlemode Pigtail: UPPLC-KIT
 - ii. 12-position fanout kit w/ 24" fanout tubing: 49887-12S
 - iii. 12-position fanout kit w/ 36" fanout tubing: 49887-12L
5. Splice trays
 - i. 12-fiber: TSPLS-12F
 - ii. 24-fiber: TSPLS-24F
 - iii. Mounting hardware: SPLMT-HKT

PART 3 — EXECUTION

3.01 GENERAL

- A. Upon completion of work, a Registered Communications Distribution Designer (RCDD) shall submit as-built drawings to the Owner and Engineer.
- B. The Contractor shall input the cabling data into the cable management software.
- C. Install all cables in accordance with project Drawings.
- D. Provide any screws, anchors, clamps, tie wraps, distribution rings, miscellaneous grounding and support hardware, etc. needed to facilitate the installation of the cable plant system.
- E. Furnish any special installation equipment or tools required to properly complete the installation.
- F. Do not roll or store cable reels without an appropriate underlay.
- G. Failure to follow the appropriate guidelines may require the installer to provide the additional material and labor required to bring the installation back into alignment with the guidelines. This shall also apply to any and all damages caused to the cables by the installer during the implementation.

- H. Provide fire blocking at all fire-rated ceiling, wall, and floor penetrations.
- I. Plug conduits where cabling has been installed in the main equipment room, backbone and other cable entrance locations with re-enterable duct seal of flame-retardant putty.
- J. Provide bushings on all conduit ends.
- K. All wiring, materials, and equipment must be listed and labeled by an NRTL. To certify that performance characteristics, meet ANSI/TIA 568 Standards, provide all Original Equipment Manufacturer (OEM) documentation to the Owner.
- L. All techniques and fixtures used in the installation must minimize complexity must allow for easy maintenance of, and ready access to, all components for test measurements.
- M. No self-tapping screws shall be used.
- N. All parts shall be made of corrosion-resistant material, such as plastic, anodized aluminum, or brass.
- O. All materials used in the installation shall be resistant to fungus growth and moisture deterioration.
- P. To avoid corrosion caused by electrolysis between dissimilar metals under the environmental operating conditions specified, separate dissimilar metals with an inert dielectric material.
- Q. All empty innerduct or conduit shall include a non-corrosive pull-rope.
- R. All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation.

3.02 BACKBONE FIBER OPTIC CABLE

- A. Install the optical fiber backbone in a continuous length between the fiber patch panels in each TR.
- B. Throughout its length, run the backbone cable in appropriate, listed raceway.
- C. Leave a 3 m long maintenance loop at each end of the link, neatly contained in the integral management rings and saddles in a "figure 8" loop at the rear of the fiber patch panel.
- D. Throughout the length of the cable, maintain the minimum bend radius and pulling force recommended by the manufacturer and required by industry standards, both during installation and after termination and testing.
- E. On each end, remove all outer jacket and strength member materials to expose the individual fiber strands or ribbons for a length of 0.5 m (18 inches).

- F. On each end, hold the cable ends securely in place with the cable clamping accessories in each fiber patch panel.
- G. Route individual strands in the rear of the fiber patch panel in a neat and orderly fashion and place them so as not to create undue stress or micro bending of the strands.

3.03 CABLE BUNDLING MATERIALS

- A. Secure all cable bundles with proper bundling or securing materials so as to ensure that the cable runs are securely held in place both vertically and horizontally.
- B. Do not tighten bundling materials or securing devices so tightly that they deform the inherent cable geometry or construction.
- C. Do not use cable ties or hook-and-loop tape to secure cable runs to other building systems such as electrical conduit, Electric Metallic Tube (EMT), sprinkler pipes, ceiling suspension members.
- D. In environmental air-handling spaces, only use appropriately-listed materials.

END OF SECTION

SECTION 27 15 13

HORIZONTAL CABLING

PART 1 — GENERAL

SUMMARY

Contractor Shall Provide and Install

The Contractor shall furnish and install telecommunications passive equipment, including:

Horizontal cable

Device connections

Related Sections:

Section 000000 – Procurement and Contracting Requirements

Section 010000 – General Requirements

Section 270000 – Common Work Results for Communications

Section 270526 – Grounding and Bonding for Communications Systems

Section 270528 – Pathways for Communications Systems

Section 270553 – Identification for Communications Systems

Section 271116 – Communications Room Equipment

Section 271700 – Testing of Structured Cabling Systems

SYSTEM DESCRIPTION

The Contractor will provide, install, and test a complete structured cabling system for the project's voice and data communications systems from the Telecommunications Outlet (TO) to the Telecommunications Room (TR), and between telecommunications spaces. The Contractor will provide and install all required components as identified below.

Horizontal Cabling

Horizontal cabling includes horizontal cable, telecommunications outlet/connectors in the Work Area (WA), mechanical terminations, and patch cords or jumpers located in a Telecommunications Room (TR).

PART 2 — PRODUCTS

HORIZONTAL UTP CABLE

Jacketing shall be rated for the environment:

CMR

CMP

Where not included in standards, Contractor shall provide as specified below.

Manufacturer:

Leviton

Category 6A Unshielded Plenum Twisted Pair Cable

Category 6A UTP Copper Cable must meet the following mechanical and performance criteria:

Exceeds requirements of ANSI/TIA-568.2-D Category 6A and ISO 11801 Class EA channel standards in a 4-conductor configuration up to 100 meters

Exceeds requirements of ANSI/TIA-568.2-D and IEC 61156-5 Category 6A component standards

Third party tested to comply with ANSI/TIA-568.2-D

Meets requirements of IEEE 802.3af, IEEE 802.3at and IEEE 802.3bt for PoE applications

Third party tested to comply with ANSI/TIA-568.2-D.

Cable diameter: Plenum 0.215 in. (5.2mm) nominal.

Installation temperature range: 32°F to 140°F (0°C to 60°C).

Operating temperature range: -4°F to 167°F (-20°C to 75°C).

Descending length cable markings enable easy identification of remaining cable which reduces installation time and cable usage.

Tested to meet or exceed 10 Gbps.

Cabling

CAT6A

Blue: Data/Workstations

Yellow: Wireless Access Points

White: Security Cameras

Red: IOT Devices

OSP

Black

Jacks

CAT6A

Blue: Data/Workstations

Yellow: Wireless Access Points

White: Security Cameras

Red: IOT Devices

Faceplates

Manufacturer: Leviton

Faceplates shall have the following attributes:

Supplied in colors and finishes coordinated with the Architect.

Have the capability for integral labeling and identification

Provide capacity for a maximum of:

Four individual jacks for single-gang applications

Provide blank inserts for unused ports.

Provide ceiling brackets for surface-mount box

Provide VXC coupler or assembly for MPTL applications.

Single and double gang plates

42080 series

Stainless steel wall plates

43080 series

Phone wall plates

4108W-1SP

Surface-mount box

41089-XWP series

CABLE BUNDLING MATERIALS

Hook and loop tape

Provide hook and loop tape, that is at least 0.5 inches wide, of a length equal to 150% of the circumference of the cable bundle.

Tie wraps are not allowed on this project.

When used in areas considered environmental air spaces, all bundling materials must be appropriately listed.

Manufacturer:

Commscope

Panduit

Or equal

PART 3 — EXECUTION

GENERAL

The Contractor shall input the cabling data into the cable management software.

Install required cables, a faceplate/surface box/furniture insert, and a jack at each location designated on the Drawings.

Provide any required screws, anchors, clamps, hook and loop, miscellaneous grounding and support hardware, etc. needed to facilitate the installation of the cable plant system.

Furnish any special installation equipment or tools necessary to properly complete the installation.

Do not roll or store cable reels without an appropriate underlay.

Failure to follow the appropriate guidelines may require the installer to provide additional material and labor required to properly rectify the situation. This shall also apply to any and all damages caused to the cables by the installer during the implementation.

Provide fire blocking at all fire rated penetrations.

Plug conduits where cabling has been installed in the main equipment room, backbone, and other cable entrance locations with re-enterable duct seal of flame retardant putty.

Provide bushings on all conduit ends.

All techniques and fixtures used in the installation must minimize complexity and must allow for easy maintenance of, and ready access to, all components for test measurements.

All materials used in installation shall be resistant to fungus growth and moisture deterioration.

All cable runs must be continuous from patch panel to the outlet location.

All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation.

WIRING PRACTICES

Group and bundle all wiring by power level or signal type.

Wire all cabling to in accordance to ANSI/TIA-568B standards.

Exercise care in wiring to avoid damaging the cables and equipment. Where conduit or chase nipples are not installed around cutouts or knockouts, use grommets.

Where wiring of different classifications shares a common enclosure or junction box, provide metallic isolation barriers to completely electrically separate wiring groups.

Coordinate with tradespeople in the field, and employ proper installation techniques, including earthing and bonding and adequate Electromagnetic Compatibility (EMC). The following table lists the distances that should be maintained between power sources and copper data cabling to avoid Electromagnetic Interference (EMI).

Condition	<2kVA	2-5kVA	>5kVA
Unshielded power lines or electrical equipment in proximity to open or non-metal pathways	6 inches	12 inches	24 inches
Unshielded power lines or electrical equipment in proximity to grounded metal conduit pathway	3 inches	6 inches	12 inches
Power lines enclosed in a grounded metal conduit (or equivalent shielding (in proximity to grounded metal conduit pathway)	2 inches	6 inches	6 inches
Transformers and Electric Motors	36 inches	36 inches	47 inches
Fluorescent lighting	12 inches	12 inches	12 inches

These guidelines apply to properly earth-bonded tray containing communications circuits in parallel with power circuits for a distance of 45 feet or more.

Communications circuits, contained in properly-bonded, ventilated trough tray, shall not be placed in the same cable tray as power circuits.

All cables shall originate and terminate at active or passive devices. Cables shall not be spliced. Where several devices are in close proximity, use approved housing to housing connectors and adapters.

Strip and terminate cabling utilizing manufacturer's recommended tools. Pins, plugs, and terminals shall not be damaged.

All cables terminated in a connection plate mounted in an enclosure shall be dressed to allow cables to be removed from the enclosure and shall be of sufficient cable length to allow for service or re-termination. The plate shall either set on the floor or freely swing clear.

Cabling shall not be visible when walking through the facility. Cabling shall be in conduits, in cable tray, or in j-hooks above accessible ceiling.

All cables installed in vertical tray or chases shall be supported by means of appropriately-sized vertical cable supports on every third floor. Do not use nylon cable ties.

Cables shall not be pulled across sharp edges. Provide protection where edges exist or manually grind down edges for a smooth, polished surface.

Cables shall not be jammed between assemblies or equipment.

Abide by manufacturer's pulling tension and bend radii.

Cable Installation in Conduit and Duct Banks

Through the entire length of all underground conduits, pull mandrel that is one size smaller than the conduit.

When pulling cable, use water-based pulling lubrication. Lubricants that harden after installation are not allowed.

During long or difficult runs, use a dynamometer to measure pulling tension. Place the dynamometer between the cable puller and the pull line to monitor pulling tension. Do not exceed the manufacturer's maximum pulling tension.

Apply pulling grips suitable for use with copper cables to the ends of the cable. Consult the cable manufacturer to determine the appropriate pulling grip and method of attachment. Use breakaway or fuse links at the pulling grip and ensure that the correct "fuse pin" is installed in the fuse link. Channel locks and pliers used for pulling are now allowed.

To protect the cable ends until they are terminated, use cable caps (heat-shrinking type) to seal the ends of the cable.

Use cable blocks to facilitate the bending of cable. For bends between 5° and 45°, use a 45° cable block. For bends between 45° and 90°, use a 90° cable block.

The bend radius for all cables shall conform to manufacturer's specifications.

HORIZONTAL UTP

Install horizontal cable in a continuous length from the point of origin to the point of termination. Group all cables and bundle them in the overhead pathways in a neat and workmanlike manner.

The Contractor shall terminate and test all cables.

The Contractor shall not exceed the manufacturer's maximum pulling tension.

Splices are not allowed.

The Contractor shall make sure that all the materials being installed on this project are of the proper rating (Plenum or Riser) required for the pathways and spaces by local, state, and federal codes.

No horizontal cables, including any required service loops, shall be more than 90 meters or 295 feet long. Prior to installation, the Contractor shall identify any area that cannot be reached within these constraints and shall report them to the Engineer. Do not install any data cable outside of these parameters without written approval from the Engineer.

Install cable paths perpendicular or parallel to the ceiling structure, unless otherwise shown on the Drawings.

Provide 6' service loop in overhead runway in MDF and IDF.

Provide 6' service loop in device backbox, nearest cable tray, or j-hook, wherever is closest to the cable termination.

Do not expose cable to water, paint overspray, paint removal products, or water-based pulling lubricants, as these substances can negatively impact the performance of the cable.

Pulling tension shall not exceed 25 lbs.

CABLE BUNDLING MATERIALS

Bundles shall not exceed 25 cables.

Use cable bundling and securing materials as required to ensure that cable runs are securely held in place both vertically and horizontally.

Do not tighten bundling materials or securing devices so as to cause deformation of the inherent cable geometry or construction.

Do not use cable ties or hook and latch tape to secure cable runs to other building systems (such as electrical conduit, EMT, sprinkler pipes, ceiling suspension members, etc.). Staples and drive rings are not allowed.

In areas considered environment air-handling spaces, only use appropriately-listed materials.

END OF SECTION

SECTION 27 16 19

PATCH CORDS

PART 1 — GENERAL

SUMMARY

Contractor Shall Provide and Install

The Contractor shall furnish and install telecommunications passive equipment, including:

Intersystem connections

Device connections

Related Sections:

Section 000000 – Procurement and Contracting Requirements

Section 010000 – General Requirements

Section 260526 – Grounding and Bonding for Electrical Systems

Section 270000 – Common Work Results for Communications

Section 270526 – Grounding and Bonding for Communications Systems

Section 270528 – Pathways for Communications Systems

Section 270539 – Surface Raceway for Communications Systems

Section 270553 – Identification for Communications Systems

Section 271116 – Communications Room Equipment

Section 271513 – Horizontal Cabling

Section 271700 – Testing of Structured Cabling Systems

SYSTEM DESCRIPTION

The Contractor will provide, install, and test a complete structured cabling system for the project's voice and data communications systems from the Telecommunications Outlet (TO) to the Telecommunications Room (TR), and between telecommunications spaces. The Contractor will provide and install all required components as identified below.

Copper Patch Cords

Fiber Patch Cords

SUBMITTALS

Copper Patch Cords

In addition to the general requirements, the Contractor shall submit the following additional data:

The length of the patch cords

The connector type for the patch cords

Fiber Patch Cords

In addition to the general requirements, the Contractor shall submit the following additional data:

The length of the patch cords

The connector type for the patch cords

Testing and Test Results

Refer to Section 27 17 00.

PART 2 — PRODUCTS

COPPER PATCH CORDS

Shall comply with Owner's standards.

Where not included in standards, Contractor shall provide as specified below.

Provide (2) patch cords per horizontal cable run.

Category 6A copper patch cords shall have the following attributes:

Cable diameter not more than 0.235 in. (5.97mm) nominal.

Category 6/Class E channel and component performance.

Exceeds all ANSI/TIA-568.2-D Category 6 and ISO 11801 Class E Edition 2.1 electrical performance requirements for all frequencies from 1 to 250 MHz

FCC and ANSI compliance: Meets ANSI/TIA/EIA-1096-A; contacts plated with 50 micro inches of gold for superior performance.

IEC compliance: Meets IEC 60603-7 c (UL) US listed: UL 1863, CSA standard C22.2.

PoE compliance: Meets IEEE 802.3af and IEEE 802.3at for PoE applications in bundle sizes up to 48 cables.

Operating temperature: 14°F to 140F (-10°C to 60°C).

Plug housing: UL94V-0 rated clear Polycarbonate.

Plug contact plated with 50 microinches of gold and rated to 2500 mating cycles

RoHS compliance: Compliant.

26AWG at work area outlets

28AWG at TR panels

Color:

Blue = Data/Workstations

Yellow = WAPs

White = Security

Red = IoT

Manufacturer

Commscope Uniprise

Panduit TX6

Work Area: 26AWG CMR

Leviton 6AS10-##* series

Telecom Room: 28AWG shielded Hi-Flex Dual Rated CM/LSZH

Leviton H6A10-##* series

Telecom Room: 28 AWG Shielded Hi-Flex Dual Rated CM/LSZH

Leviton H6A1i-## series

Above Ceilings: 26AWG, Plenum CMP

Leviton 6ASP0-## series

CABLE BUNLDING MATERIALS

Hook and loop tape

Provide hook and loop tape, that is at least 0.5 inches wide, of a length equal to 150% of the circumference of the cable bundle.

Tie wraps are not allowed on this project.

When used in areas considered environmental air spaces, all bundling materials must be appropriately listed.

Manufacturer:

Commscope

Or equal

FIBER PATCH CORDS

Shall comply with Owner's standards.

Where not included in standards, Contractor shall provide as specified below.

Patch cords shall be LC-to-LC, depending on equipment.

Patch cords shall be 1, 2, 3, 5, or 10 meters long.

Manufacturer:

Leviton UPDLC-SXX series

PART 3 — EXECUTION

GENERAL

The Contractor shall input the cabling data into the cable management software.

Provide any required screws, anchors, clamps, hook and loop, miscellaneous grounding and support hardware, etc. needed to facilitate the installation of the cable plant system.

Furnish any special installation equipment or tools necessary to properly complete the installation.

Failure to follow the appropriate guidelines may require the installer to provide additional material and labor required to properly rectify the situation. This shall also apply to any and all damages caused to the cables by the installer during the implementation.

All techniques and fixtures used in the installation must minimize complexity and must allow for easy maintenance of, and ready access to, all components for test measurements.

All materials used in installation shall be resistant to fungus growth and moisture deterioration.

All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation.

WIRING PRACTICES

All cables shall originate and terminate at active or passive devices. Where several devices are in close proximity, use approved housing to housing connectors and adapters.

All cables terminated in a connection plate mounted in an enclosure shall be dressed to allow cables to be removed from the enclosure and shall be of sufficient cable length to allow for service or re-termination. The plate shall either set on the floor or freely swing clear.

Do not use nylon cable ties.

CABLE BUNDLING MATERIALS

Use cable bundling and securing materials as required to ensure that cable runs are securely held in place both vertically and horizontally.

Do not tighten bundling materials or securing devices so as to cause deformation of the inherent cable geometry or construction.

Do not use cable ties or hook and latch tape to secure cable runs to other building systems (such as electrical conduit, EMT, sprinkler pipes, ceiling suspension members, etc.).

In areas considered environment air-handling spaces, only use appropriately listed materials.

IDENTIFICATION

Before installing or terminating cable, confirm all specific labeling requirements with the Owner or the Owner's Engineer.

Cables

Mark each cable at each endpoint and at all intermediate pull and access points, and junction boxes with labels that indicate the origination and destination identifiers, the sheath identifier, and the strand or pair range.

Mark each horizontal cable on the sheath at each end with the TR, patch panel, and panel port to which the cable is wired.

END OF SECTION

SECTION 27 17 00

TESTING OF STRUCTURED CABLING SYSTEMS

PART 1 — GENERAL

1.01 SUMMARY

- A. This Section includes the minimum requirements for the test certification, identification, and administration of horizontal balanced twisted pair cabling and optical fiber cabling.
- B. The Contractor provides all labor, materials, tools, field-test instruments and equipment required for the complete testing, identification and administration of the work called for in the Contract Documents.
- C. In order to conform to the overall project event schedule, the cabling Contractor shall survey the work areas and coordinate cabling testing with other applicable trades.
- D. In addition to the tests detailed in this document, the Contractor shall notify the Owner or the Owner's representative of any additional tests deemed necessary to guarantee a fully functional system. The Contractor shall carry out and record any additional measurement results at no additional charge.

1.02 SCOPE

- A. This Section includes the minimum requirements for:
 - 1. Identification, including labels and labeling
 - 2. Administration, including:
 - i. Test results documentation
 - ii. As-built drawings
 - 3. The testing of copper cabling, including:
 - i. Test instruments
 - ii. Test procedures
 - 4. The testing of fiber optic cabling, including:
 - i. Test instruments
 - ii. Test procedures
- B. Testing shall be carried out in accordance with this document. The Contractor shall:
 - 1. Test all installed balanced twisted pair cabling permanent links to the applicable performance level.
 - 2. Test the attenuation and polarity of the installed optical fiber cable plant with an Optical Loss Test Set (OLTS)

3. Test the installed condition of the optical fiber cabling system and its components with an Optical Time Domain Reflectometer (OTDR)
 4. Verify the condition of the fiber end faces
- C. The Contractor shall document all tests including:
1. OLTS dual wavelength attenuation measurements
 2. OTDR traces with event tables and OTDR maps – Edit or remove this item as appropriate for the project.
 3. Optical length measurements and pictures of the connector end faces

1.03 RELATED SECTIONS

- A. Section 000000 – Procurement and Contracting Requirements
- B. Section 010000 – General Requirements
- C. Section 260526 – Grounding and Bonding for Electrical System
- D. Section 270526 – Grounding and Bonding for Communications Systems
- E. Section 270528 – Pathways for Communications Systems
- F. Section 270539 – Surface Raceway for Communications Systems
- G. Section 270553 – Identification for Communications Systems
- H. Section 271316 – Communications Room Equipment
- I. Section 271513 – Horizontal Cabling
- J. Section 271619 – Communications Patch Cords

1.04 REFERENCES

- A. Requirements, Codes, and Standards
 1. All testing procedures and field test instruments shall comply with the applicable requirements of the following standards including the most current revisions, addendums, and any Technical Service Bulletins (TSBs) released at the time of bid:
 - i. ANSI Z136.2, ANSI For Safe Use of Optical Fiber Communication Systems Utilizing Laser Diode and LED Sources
 - ii. ANSI/EIA/TIA 455 50B, Light Launch Conditions For Long-Length Graded-Index Optical Fiber Spectral Attenuation Measurements
 - iii. ANSI/TIA/EIA-455-59A, Measurement of Fiber Point Discontinuities Using an OTDR

- iv. ANSI/TIA/EIA 455 60A, Measurement of Fiber or Cable Length Using an OTDR
- v. ANSI/TIA/EIA 455 61A, Measurement of Fiber or Cable Attenuation Using an OTDR
- vi. ANSI/TIA/EIA 526 7, Optical Power Loss Measurements of Installed Single-mode Fiber Cable Plant
- vii. ANSI/TIA 526 14 B, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; IEC 61280-4-1 edition 2, Fibre-Optic Communications Subsystem Test Procedure- Part 4-1: Installed cable plant- Multimode attenuation measurement
- viii. TIA-TSB-4979 Practical Considerations for Implementation of Multimode Launch Conditions in the Field
- ix. ANSI/TIA-1152, Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
- x. ANSI/TIA-568-0. D, Generic Telecommunications Cabling for Customer Premises.
- xi. ANSI/TIA-568-1. D, Commercial Building Telecommunications Cabling Standard
- xii. ANSI/TIA 568.2-D, Balanced Twisted-Pair Telecommunications Cabling and Components Standards.
- xiii. ANSI/TIA 568 C.3, Optical Fiber Cabling Components Standard
- xiv. ANSI/TIA-606-C, Administration Standard for Commercial Telecommunications Infrastructure, including the requirements specified by the customer, unless the customer specifies their own labeling requirements.

B. Applicability of Codes, Rules, and Regulations

- 1. Federal, state, and local codes, rules, regulations, and ordinances governing the work, are as fully part of the specifications as if herein repeated or hereto attached.
- 2. If the Contractor notes items in the drawings or the specifications, construction of which would be code violations, the Contractor should promptly call them to the attention of the Owner's representative in writing.
- 3. Where the requirements of other sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply.
- 4. **Balanced Twisted Pair Testing**

- i. Trained technicians, who have successfully attended an appropriate training program and have obtained a certificate as proof thereof, shall execute the tests. Acceptable certificates are ones that have been issued by any of the following organizations or an equivalent organization:
 5. The manufacturer of the connectors and/or the cable
 6. The manufacturer of the test equipment used for the field certification
 7. Training organizations such as Building Industry Consulting Service International (BICSI), the Association of Cabling Professionals™ (ACP), the Cabling Business Institute (CBI)
- C. Optical Fiber Testing
1. Trained technicians who have successfully attended an appropriate training program, which includes testing with an OLTS and an OTDR and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
 2. The manufacturer of the connectors and/or the cable
 3. The manufacturer of the test equipment used for the field certification
 4. Training organizations such as Building Industry Consulting Service International (BICSI), the Association of Cabling Professionals™ (ACP), the Cabling Business Institute (CBI)
- D. Owner's Participation
1. The Owner or the Owner's representative shall be invited to witness and/or review field testing.
 2. Five business days before testing commences, the Owner or the Owner's representative shall be notified of the start date of the testing phase.
 3. The Owner or the Owner's representative shall:
 - i. Select a random sample of five percent of the installed links.
 - ii. Test these randomly-selected links.
 - iii. Store the results in accordance with Part 3 of this document.
 4. The Contractor shall compare the results obtained by the Owner to the data provided by the installation Contractor. If more than two percent of the pass/fail determinations in the sample results differ from the data provided by the installation Contractor, the Contractor, under the supervision of the Owner's representative, shall repeat one hundred percent of the testing at no cost to the Owner.

1.05 SUBMITTALS

- A. The Contractor shall submit the following:
 - 1. The manufacturer's catalog sheets and specifications for the test equipment.
 - 2. A schedule (list) of all links and channels to be tested.
 - 3. Sample test reports.
 - 4. The test equipment serial number.
 - 5. A graphic diagram documenting the test procedure, including all connectors, the light source (as applicable,) the origin, and the destination of each cable tested.

1.06 CLOSEOUT DOCUMENTS

- A. Submit test equipment along with test results.

1.07 TEST RESULTS

- A. Fiber test results shall be submitted in sequential order by telecommunications space they are terminated in.
- B. Category cable test results shall be submitted in sequential order by telecommunications space they are terminated in, and then by unique label identifier.
- C. Balanced Twisted Pair Links
 - 1. Category 6 Balanced Twisted Pair
 - i. Unless otherwise specified by the Owner or the Owners representative, each Category 6 balanced twisted pair cabling link shall be tested for:
 - a) Wire Map
 - b) Length
 - c) Propagation Delay
 - d) Delay Skew
 - e) DC Loop Resistance
 - f) DC Resistance Unbalance within a pair
 - g) DC Resistance Unbalance between pairs
 - h) Insertion Loss
 - i) Near-End Crosstalk (NEXT)
 - j) Power Sum Near-End Crosstalk (PS NEXT)
 - k) Attenuation to Crosstalk Ratio Near-End (ACR-N)

- l) Power Sum Attenuation to Crosstalk Ratio Near-End (PS ACR-N)
- m) Attenuation to Crosstalk Ratio Far-End (ACR-F)
- n) Power Sum Attenuation to Crosstalk Ratio Far-End (PS ACR-F)
- o) Return Loss
- p) Transverse Conversion Loss (TCL)
- q) Equal Level Transverse Conversion Transfer Loss (ELTCTL)

2. Category 6A Balanced Twisted Pair

- i. Category 6A link shall be tested for all of the parameters listed above for Category 6 as well as the following additional parameters:
 - a) Power Sum Alien Near-End Crosstalk (PS ANEXT)
 - b) Average Power Sum Alien Near-End Crosstalk (Average PS ANEXT)
 - c) Power Sum Alien Attenuation to Crosstalk Ratio Far-End (PS AACR-F)
 - d) Average Power Sum Alien Attenuation to Crosstalk Ratio Far-End (Average PS AACR-F)

3. When a Balanced Twisted Pair Permanent Link Fails

- i. All installed balanced twisted pair cabling permanent links shall be field-tested and shall pass the test requirements and analysis described in Part 3.
- ii. Any permanent link that fails these requirements shall be diagnosed and corrected.
- iii. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected permanent link meets performance requirements.
- iv. The final and passing result of the tests for all permanent links shall be provided in the test results documentation, in accordance with Part 3.

D. Optical Fiber Links

- 1. Test Limits – ANSI/TIA-568.3-D Singlemode (STD) and Multimode (STD)

2. Unless otherwise specified by the Owner or the Owners representative, each optical fiber cabling link shall comply with the following test limits:
 - i. Optical loss testing
 - ii. Multi-mode and single-mode links
 - iii. Link attenuation calculated by the formulas, as specified in ANSI/TIA 568 C.O:
 - a) $\text{Link Attenuation (dB)} = \text{Cable Attn (dB)} + \text{Connector Attn (dB)} + \text{Splice Attn (dB)}$
 - b) $\text{Cable Attn (dB)} = \text{Attenuation Coefficient (dB/km)} * \text{Length (Km)}$
 - c) $\text{Connector Attn (dB)} = \text{number of connector pairs} * \text{connector loss (dB)}$ Maximum allowable connector loss = 0.75 dB
 - d) $\text{Splice\_Attn (dB)} = \text{number\_of\_splices} * \text{splice\_loss (dB)}$ Maximum allowable splice_loss = 0.3 dB
 - iv. The values for the Attenuation_Coefficient (dB/km) are listed in the table below. Where application limits are more stringent, those shall apply.

		<i>attenuation</i>		<i>attenuation</i>
<i>type of optical fiber</i>	<i>wavelength</i>	<i>coefficient</i>	<i>wavelength</i>	<i>coefficient</i>
	<i>(nm)</i>	<i>(dB/km)</i>	<i>(nm)</i>	<i>(dB/km)</i>
Multi-mode 62.5/125 μm	850	3.5	1300	1.5
Multi-mode 50/125 μm	850	3.5	1300	1.5
Single-mode (Inside plant)	1310	1.0	1550	1.0
Single-mode (Outside plant)	1310	0.5	1550	0.5

3. OTDR Testing
 - i. Reflective events (connections) shall not exceed the following limits. Where application limits are more stringent, those shall apply.
 - a) 0.75 dB in optical loss when bi-directionally averaged
 - b) -35 dB reflectance for multi-mode connections

- c) -40 dB reflectance for UPC single-mode connections
- d) -55 dB reflectance for APC single-mode connections
- e) Non-reflective events (splices) shall not exceed 0.3 db

4. Magnified End Face Inspection

- i. Fiber connections shall be visually inspected for compliance with IEC 61300 3 35 Edition 1.0 for end face quality.
- ii. Scratched, pitted or dirty connectors shall be diagnosed and corrected.

5. When an Optical Fiber Link or Channel Fails

- i. All installed optical fiber cabling links and channels shall be field-tested and pass the test requirements and analysis as described in Part 3.
- ii. Any link or channel that fails these requirements shall be diagnosed and corrected.
- iii. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link or channel meets performance requirements.
- iv. The final and passing result of the tests for all links and channels shall be provided in the test results documentation, in accordance with Part 3.

E. Acceptance of Test Results

- 1. Once the project is fully completed and tested in accordance with the Contract Documents and to the satisfaction of the Owner, the Owner's acceptance of the test results shall be given in writing to the Engineer.

1.08 PROJECT CONDITIONS

A. Project Environmental Requirements

1. Seismic Safety

- i. Observe mechanical and electrical support means for all installed equipment as required by all applicable local building codes for this installation's earthquake risk hazard zone and as recommended by Telcordia Specification GR-63.
- ii. All equipment racks should be anchored with suitable anchors that meet safety standards.
- iii. Overhead devices should be mounted with appropriate safety attachments as required.

- iv. Where cabinets and racks are secured directly to the building, this should be done in accordance with guidance provided by the Authority Having Jurisdiction (AHJ) or a structural engineer.
 - v. Equipment and fixtures should have shock and vibration isolation.
2. Fiber Optic Cable Safety
- i. The following warnings shall be posted on the job site:

WARNING: PERMANENT EYE DAMAGE CAN RESULT FROM LOOKING DIRECTLY INTO A LIGHT BEAM GENERATED BY AN LED OR LASER SOURCE OR INTO THE END OF A CABLE FIBER CONNECTED TO ONE OF THESE SOURCES.

CAUTION: LIGHT GENERATED BY THESE SOURCES MAY NOT BE VISIBLE YET REMAIN HAZARDOUS TO THE EYE. LOOK FOR WARNING LABELS ON SOURCE DEVICES.
 - ii. Observe all warning signs on equipment and all written safety precautions in the equipment instruction and technical manuals.
 - iii. Always handle cable carefully to avoid personal injury. Care should be taken with individual fibers to prevent injury to the eyes or penetration of the fibers into the skin.

PART 2 — PRODUCTS

2.01 BALANCED TWISTED-PAIR CABLE TESTERS

- A. The field test instrument shall be manufactured by Fluke Networks.
- B. The field test instrument shall have been calibrated within the last twelve months.
- C. There shall be independent verification that the field test instrument meets the following accuracy requirements:
 - 1. For Category 6, Level III accuracy in accordance with ANSI/TIA 1152
 - 2. For Category 6A, Level IIIe accuracy in accordance with ANSI/TIA 1152
- D. Permanent Link Adapters
 - 1. The RJ45 plug must meet the requirements for NEXT, FEXT, and Return Loss in accordance with ANSI/TIA 568.2-D.
 - 2. Twisted pair Category 6/6A cords are not permitted, as their performance degrades with use and can cause false Return Loss failures.
- E. Results Storage

1. The field test instrument shall be capable of storing more than 10,000 results for all measurements found within this section.

F. Measurement Capabilities for Category 6 Links

1. On Category 6 links, the field test instrument shall be capable of testing the following parameters:
 - i. Wire Map
 - ii. Length
 - iii. Propagation Delay
 - iv. Delay Skew
 - v. DC Loop Resistance
 - vi. DC Resistance Unbalance within a pair
 - vii. DC Resistance Unbalance between pairs
 - viii. Insertion Loss
 - ix. Near-End Crosstalk (NEXT)
 - x. Power Sum Near-End Crosstalk (PS NEXT)
 - xi. Attenuation to Crosstalk Ratio Near-End (ACR-N)
 - xii. Power Sum Attenuation to Crosstalk Ratio Near-End (PS ACR-N)
 - xiii. Attenuation to Crosstalk Ratio Far-End (ACR-F)
 - xiv. Power Sum Attenuation to Crosstalk Ratio Far-End (PS ACR-F)
 - xv. Return Loss
 - xvi. Transverse Conversion Loss (TCL)
 - xvii. Equal Level Transverse Conversion Transfer Loss (ELTCTL)
 - xviii. Time Domain Reflectometer
 - xix. Time Domain Xtalk Analyzer

G. Measurement Capabilities for Category 6A

1. On Category 6A links, the field test instrument shall be capable of testing all of the parameters listed above for Category 5E and Category 6 links and all of the following parameters:
 - i. Power Sum Alien Near-End Crosstalk (PS ANEXT)
 - ii. Average Power Sum Alien Near-End Crosstalk (Average PS ANEXT)

- iii. Power Sum Alien Attenuation to Crosstalk Ratio Far-End (PS AACR-F)
 - iv. Average Power Sum Alien Attenuation to Crosstalk Ratio Far-End (Average PS AACR-F)
- H. PC Software
 - 1. The field test instrument's PC software shall:
 - i. Be Windows® based
 - ii. Show when 3 dB and 4 dB rules are applied
 - iii. Have re-certification capability where results have "(RC)" added to the end of the Cable IDs
 - iv. Have a built-in PDF export capability, as no additional third party software is permitted
 - v. Have built-in statistical analysis

2.02 OPTICAL FIBER CABLE TESTERS

- A. The field test instrument shall have been calibrated within the period recommended by the manufacturer, and a copy of the calibration certificate shall be made available.
- B. Optical Loss Test Set (OLTS)
 - 1. Multi-Mode Optical Fiber Light Source
 - 2. The multi-mode optical fiber light source shall:
 - i. Provide dual LED light sources with central wavelengths of 850 nm (± 30 nm) and 1300 nm (± 20 nm). VCSEL sources are not permitted per ANSI/TIA 526 14 B.
 - ii. Have output power of at least -20 dBm
 - iii. Meet the Encircled Flux launch requirements of ANSI/TIA 526 14 B
 - iv. Have test reference cords that demonstrate an insertion loss of 0.15 dB when mated against each other
 - v. Be manufactured by Fluke Networks
 - 3. The single-mode optical fiber light source shall:
 - i. Provide dual laser light sources with central wavelengths of 1310 nm (± 20 nm) and 1550 nm (± 20 nm).
 - ii. Have output power of at least -10 dBm
 - iii. Have test reference cords that demonstrate an insertion loss of 0.25 dB when mated against each other

- iv. Be manufactured by Fluke Networks
- 4. Power Meter shall:
 - i. Provide test capability at wavelengths of 850 nm, 1300 nm, 1310 nm, and 1550 nm
 - ii. Have power measurement uncertainty of ± 0.25 dB
 - iii. Store reference power measurements
 - iv. Save at least 10,000 results to internal memory
 - v. Have a USB PC interface
 - vi. Be manufactured by Fluke Networks
- 5. Optional Length Measurement
 - i. An OLTS capable of measuring the optical length of the fiber using time-of-flight techniques is preferable.
 - ii. For MPO/MTP trunk cables, length shall be calculated using cable jacket length markings.
- C. Optical Time Domain Reflectometer (OTDR)
 - 1. The OTDR shall:
 - i. Have a color LCD display with backlight
 - ii. Have rechargeable Li-Ion battery for 8 hours of normal operation
 - iii. With battery and module, weigh no more than 4.5 pounds and have a volume of no more than 200 in²
 - iv. Have internal non-volatile memory with capacity for storing at least 2,000 OTDR bi-directionally-tested fiber links
 - v. Have a USB port to transfer data to a PC or thumb drive/memory stick
 - vi. Be manufactured by Fluke Networks
 - 2. The multi-mode OTDR shall:
 - i. Provide test capability at wavelengths of 850 nm (± 10 nm) and 1300 nm ($+35$ nm / -15 nm)
 - ii. Have event dead zones that do not exceed 0.7 m at 850 nm and 1300 nm
 - iii. Have attenuation dead zones that do not exceed 2.5 m at 850 nm and 4.5 m at 1300 nm

- iv. Have distance range of at least 9,000 m
 - v. Have a dynamic range of at least 28 dB for 850 nm and 30 dB at 1300 nm
 - vi. Allow bi-directional testing without moving the OTDR to the far end
3. The single-mode OTDR shall:
- i. Provide test capability at wavelengths of 1310 nm (± 25 nm) and 1550 nm (± 30 nm)
 - ii. Have event dead zones that do not exceed 0.6 m at 1310 nm and 1550 nm
 - iii. Have attenuation dead zones that do not exceed 3.7 m at 1310 nm and 1550 nm
 - iv. Have distance range of at least 80 km at 1310 nm and 130 km at 1550 nm
 - v. Have a dynamic range of at least 32 dB for 1310 nm and 30 dB at 1550 nm
 - vi. Allow bi-directional testing without moving the OTDR to the far end
- D. Fiber Microscope
1. The fiber microscope shall:
- i. Have a field of view of 420 μm by 320 μm
 - ii. Have camera probe tips that permit inspection through adapters
 - iii. Be capable of saving and reporting the end face image to IEC 613003 35
 - iv. Be manufactured by Fluke Networks
 - v. Preferably be a video camera system
- E. Integrated OLTS, OTDR, and Fiber Microscope
- 1. Test equipment that combines an OLTS, an OTDR, and a fiber microscope into one instrument may be used.
 - 2. Any such system shall be manufactured by Fluke Networks.

PART 3 — EXECUTION

3.01 GENERAL

- A. Prior to field-testing, all outlets, cables, patch panels, and associated components shall be fully assembled and labeled. Any testing performed on incomplete systems shall be redone after the systems are fully assembled and labeled.
- B. The Contractor shall input the cabling data into the cable management software.

3.02 CABLE TERMINATION AND TEST PLANS

A. General

- 1. Provide proof of testing technician(s) certification for operation of the specific units of test equipment, which are proposed for use.
- 2. The Contractor shall obtain General Contractor approval for each termination and test plan prior to execution of the work.
- 3. This Section covers work necessary to furnish communications system testing, including the following:
 - i. Outside Plant (OSP) Cabling Infrastructure (Campus LAN/WAN extension)
 - ii. Back-Bone Cabling Infrastructure
 - iii. Horizontal Cabling Systems
- 4. Inspection Requirements:
 - i. As part of any performance test, inspect cable, material, and equipment for physical damage, continuity, and proper connection.
 - ii. Verify identification and labeling at required locations for visibility, condition, legibility, and accuracy.
- 5. Test Report Requirements – Each test report shall include the following sections:
 - i. Scope of testing
 - ii. List of equipment used in the test with a photocopy of the factory calibration certificate.
 - iii. List of technicians performing the tests identified in the scope of testing.
 - iv. Summary of test results: Hardcopy and electronic copies of the summary forms are to be delivered at conclusion of the project before final payment will be made.
 - v. Individual test data sheets: The individual test data sheets shall be developed and completed by the Contractor. Formatted output from cable scanners is typically acceptable provided they contain all of the test parameters including graphs of the information required by this Section.

B. Cable Termination Plans

1. Submit detailed termination plans for both fiber optic and twisted pair cables, which describe how each system component will be installed and terminated.

C. Cable Test Plans

1. Submit detailed test plans for both fiber optic and twisted-pair cable channels which include at least the following information:
 - i. Describe the tests to be performed.
 - ii. Explain when and how each system component will be tested.
 - iii. List the test equipment to be used.
 - iv. Itemize how theoretical loss budgets and test parameters will be calculated and listed.
 - v. Provide an example of the test reporting documentation for each type of test, which provides a written verification of the results, as required in paragraph 2 below.
2. Provide testing documentation which includes:
 - i. Dates and times of test
 - ii. Personnel performing tests
 - iii. Initial test results
 - iv. Description of discrepancies found or failure, if any
 - v. Corrective action, if any
 - vi. Date and person performing corrections
 - vii. Retest results, if required
 - viii. Include space for Owner's sign-off
 - ix. Copy of test equipment calibration certificates
 - x. Intrabuilding (Vertical and Horizontal Subsystem) fiber optic segment post-installation test plan
3. Twisted-Pair Cable Tests: Testing shall be performed using a minimum level IIIe tester, approved by the engineer.
4. Twisted-Pair Test Plans: Provide separate post-installation test schemes for the following activities:
 - i. Backbone Subsystem twisted-pair segment test plan.

- ii. Horizontal Subsystem twisted-pair segment test plan.
- 5. Fiber-Optic Cable Tests: Testing shall be performed using a level IIIe tester, with approved test-heads approved by the engineer.
- 6. Fiber-Optic Test Plans: Provide separate post-installation test schemes for the following activities:
 - i. Backbone subsystem fiber-optic segment test plan.
 - ii. Horizontal subsystem fiber-optic segment test plan.

3.03 SYSTEM ADMINISTRATION

A. Test Results Documentation

- 1. At the end of each working day, upload the copper cable permanent link test results, except for alien crosstalk testing, to the associated PC software for inspection by the Owner or the Owner's representative.
- 2. Test results uploaded shall allow for the maintenance, inspection, and archiving of the test records.
- 3. Prior to the Owner accepting the project:
 - i. Store the database of the complete project, including, if applicable, fiber links, in the format native to the software.
 - ii. Deliver the database to the Owner on CD, DVD, or thumb-drive.
 - iii. To allow the Owner to inspect and print the test reports, include a working and fully-licensed copy of the software.
- 4. Circuit IDs reported by the test instrument should match the specified label ID.
- 5. Provide the detailed test results documentation data, in an electronic database, for each tested optical fiber and include the following information:
 - i. The identification of the customer site as specified by the end-user.
 - ii. The name of the test limit selected to execute the stored test results.
 - iii. The name of the personnel performing the test.
 - iv. The date and time that the test results were saved in the memory of the tester.
 - v. The manufacturer, model, and serial number of the field test instrument.
 - vi. The version of the test software and the version of the test limit database held in the test instrument.
 - vii. The fiber identification number.

- viii. The length of each optical fiber.
- ix. The index of refraction used for length calculation when using a length-capable OLTS.
- x. The backscatter coefficient of the fiber under test when using an OTDR.
- xi. The OLTS attenuation link and channel measurements at the appropriate wavelengths and the margin (the difference between the measured attenuation and the test limit value).
- xii. The OTDR link and channel traces, event tables at the appropriate wavelengths, and a map of the link tested.
- xiii. The length of each optical fiber, as calculated by the OTDR.
- xiv. The overall pass/fail evaluation of the link-under-test for OLTS and OTDR measurements.
- xv. A picture or image of each fiber end-face.
- xvi. A pass/fail status of the end-face using IEC 61300-3-35 Edition 1.0.

6. Testing of Category 6 Permanent Links

- i. For each Category 6 balance twisted-pair permanent link, provide the detailed test results documentation data in the associated PC software including:
- ii. The overall pass/fail evaluation of the link-under-test.
- iii. The date and time the test results were saved in the memory of the tester.
- iv. The identification of the customer site, as specified by the Owner.
- v. The name of the test limit selected to execute the stored test results.
- vi. The name of the personnel performing the test.
- vii. The version of the test firmware and the version of the test limit database held in the test instrument.
- viii. The manufacturer, model, and serial number of the field test instrument.
- ix. The adapters used.
- x. The factory calibration date.
- xi. Wire map.
- xii. Propagation delay values for all four pairs.
- xiii. Delay skew values for all four pairs.

- xiv. DC resistance values for all four pairs.
- xv. DC resistance unbalance within a pair values for all four pairs.
- xvi. DC resistance unbalance between pairs values for all four pairs.
- xvii. Insertion loss worst case values for all four pairs.
- xviii. NEXT worst-case margin and worst-case values in both directions.
- xix. PS NEXT worst-case margin and worst-case values in both directions.
- xx. ACR-N worst-case margin and worst-case values in both directions.
- xxi. PS ACR-N worst-case margin and worst-case values in both directions.
- xxii. ACR-F worst-case margin and worst-case values in both directions.
- xxiii. PS ACR-F worst-case margin and worst-case values in both directions.
- xxiv. Return loss worst-case margin and worst-case values in both directions.
- xxv. TCL worst-case margin and worst-case values in both directions.
- xxvi. ELTCTL worst-case margin and worst-case values in both directions.
- xxvii. Time domain crosstalk data, if the link is marginal or fails.
- xxviii. Time domain reflectometer data, if the link is marginal or fails.

7. Testing of Category 6A Permanent Links

- i. For each Category 6A balance twisted-pair permanent link, provide all of the same detailed test results documentation data required for Category 6 permanent links and also the detailed test results documentation data for alien crosstalk testing, in AxTalk Analyzer, including:
- ii. PS ANEXT worst-case margin for all four pairs.
- iii. Average PS ANEXT worst-case margin.
- iv. PS AACR-F worst-case margin for all four pairs.

3.04 FIELD QUALITY CONTROL

A. General

- 1. The Owner reserves the right to be present during any or all of the testing.
- 2. All cabling not tested in strict accordance with these specifications shall be re-tested at no additional cost to the Owner.
- 3. 100% of the installed cabling must be tested. All tests must meet the acceptance criteria defined in the media specific sections of this document.

4. Prior to each day's testing, fully charge all test equipment and bring an appropriate alternate power source to the job site.
5. Throughout the testing, have a competent supervisor and supporting technical personnel, acceptable to the Owner, available on site. Changing the supervisor during the testing shall not be acceptable without prior written approval from the Owner.
6. Upon completion of the testing, it shall be the responsibility of the Contractor to perform the necessary adjustments and other controls to ensure proper system operation. The system shall be physically inspected by the Owner to assure that all equipment is installed in a neat and workmanlike manner as called for by the contract documents.
7. Verify the performance parameters of the individual systems, following established professional procedures, in addition to those specified herein. Document all acceptance testing, calibration, and correction procedures described herein, taking care to include the following information:
 - i. The date on which each procedure was performed.
 - ii. The reason that the procedure was performed.
 - iii. The type of and a description of the procedure.
 - iv. The parameters measured and their values, including, as applicable, the values measured prior to calibration or correction.
 - v. The parameters associated with calibration or corrective networks, components, or devices.
 - vi. The names of the personnel conducting the procedure.
 - vii. The equipment used to conduct the procedure.

B. General Specifications for Testing Balanced Twisted Pair Cable

1. Use field test instruments that have the latest firmware installed.
2. Upon completion of each test, record the permanent link test results, including the individual frequency measurements from the tester, in the test instrument for subsequent uploading to the associated test equipment software in which the administrative documentation (reports) may be generated.
3. Perform permanent link testing on each cabling segment, connector to connector. Sampling is not acceptable.
4. Perform alien crosstalk testing on all Category 6A links using a sampling plan. For populations of up to 500,000 links, use an Acceptance Quality Level (AQL) of 0.4%, normal inspection, general inspection level I, as defined in ISO 2859 1. The following table lists the sample sizes to be used.

<i>total number of links (N)</i>	<i>sample size (No. of links to test)</i>
3 – 33	3 or 0.1 x N (whichever is greatest)
34 – 3,200	33
3,201 – 35,000	126
35,001 – 150,000	201
150,001 – 500,000	315

5. Choose an equal combination of short, medium, and long disturbed (victim) links for alien crosstalk testing.
6. Permanent link adapters made from twisted pair Category 6, or Category 6A cords are not permitted.
7. The installer shall build a reference Category 6A link. All components shall be anchored so that it is not possible to disturb them. Each day, the technician is to conduct a Category 6A permanent link test to ensure that there is no degradation of the tester or its permanent link adapters.

3.05 TESTING CATEGORY 6 LINKS

- A. Frequency Resolution for all measurements shall be:
 1. 1 – 31.25 MHz: 150 kHz
 2. 31.25 – 100 MHz: 250 kHz
 3. 100 – 250 MHz: 500 kHz
- B. Wire Map Measurement
 1. The length of each balanced twisted pair shall be recorded.
- C. Propagation Delay
 1. Make the propagation delay measurement, per ANSI/TIA 1152, at 10 MHz.
 2. Record the propagation delay of each balanced twisted pair.
 3. Propagation delay shall not exceed 498 ns per ANSI/TIA 568 C.2 Section 6.3.18
 4. Record the delay skew measurement for each balanced twisted pair.
 5. Per ANSI/TIA 568 C.2 Section 6.3.19, propagation delay is not to exceed 44 ns.
 6. Record DC resistance for all four pairs.

7. Record DC resistance unbalance for all four pairs.
- D. Insertion Loss
1. Report the worst case for all four pairs in one direction only.
 2. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
 3. Insertion loss is not to exceed the limits for Category 6 permanent links specified in ANSI/TIA 568 C.2 Section 6.3.7.
- E. Near-End Crosstalk (NEXT)
1. Measure NEXT in both directions for all 12 possible pair-to-pair combinations.
 2. Report both worst case and worst margins.
 3. NEXT is not to exceed the limits for Category 6 permanent links specified in ANSI/TIA 568 C.2 Section 6.3.8.
 4. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
 5. Store the time domain Xtalk data for any marginal or failing NEXT results.
- F. Power Sum Near-End Crosstalk (PS NEXT)
1. Measure PS NEXT in both directions for all 8 possible pair combinations.
 2. Report both worst case and worst margins.
 3. PS NEXT is not to exceed the limits for Category 6 permanent links specified in ANSI/TIA 568 C.2 Section 6.3.9.
 4. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
 5. Store the time domain Xtalk data for any marginal or failing PS NEXT results.
- G. Attenuation Crosstalk Ratio Near-End (ACR-N)
1. Calculate ACR-N in both directions.
 2. Record ACR-N for all 12 possible combinations.
- H. Power Sum Attenuation Crosstalk Ratio Near-End (PS ACR-N)
1. Calculate PS ACR-N in both directions.
 2. Record PS ACR-N for all 8 possible combinations.
- I. Attenuation Crosstalk Ratio Far-End (ACR-F)

1. Measure ACR-F in both directions for all 24 possible pair-to-pair combinations.
2. Report both worst case and worst margins.
3. ACR-F is not to exceed the limits for Category 6 permanent links specified in ANSI/TIA 568 C.2 Section 6.3.11.
4. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).

J. Return Loss

1. Measure return loss in both directions for all 8 possible pair combinations.
2. Report worst case and worst margins.
3. Ignore return loss at all frequencies where the insertion loss is less than 3 dB for that pair.
4. Return loss is not to exceed the limits for Category 6 permanent links specified in ANSI/TIA 568 C.2 Section 6.3.6.
5. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
6. Store the time domain reflectometer data for any marginal or failing return loss results.

K. Transverse Conversion Loss (TCL)

1. Measure TCL in both directions.
2. TCL for a permanent link is not specified in ANSI/TIA 1152 but record it for all 8 possible combinations.

L. Equal Level Transverse Conversion Transfer Loss (ELTCTL)

1. Measure ELTCTL in both directions.
2. Record ELTCTL for all 8 possible combinations.

3.06 TESTING CATEGORY 6A LINKS

A. Frequency Resolution for all measurements shall be:

1. 1 – 31.25 MHz: 150 kHz
2. 31.25 – 100 MHz: 250 kHz
3. 100 – 250 MHz: 500 kHz
4. 250 – 500 MHz: 1000 kHz

B. Wire Map Measurement

1. Record the length of each balanced twisted pair.
- C. Propagation Delay
1. Measure the propagation delay, per ANSI/TIA-1152, at 10 MHz.
 2. Record the propagation delay of each balanced twisted pair.
 3. Per ANSI/TIA 568 C.2 Section 6.3.18, the propagation delay shall not exceed 498 ns.
- D. Delay Skew
1. Record the delay skew measurement for each balanced twisted pair.
- E. DC Loop Resistance
1. Report the DC loop resistance for all four pairs.
 2. Per ANSI/TIA 568 C.2 Section 6.3, DC loop resistance is not to exceed 21 Ω for all four pairs.
- F. DC Resistance Unbalance within a Pair
1. Report DC resistance unbalance within a pair for all four pairs.
 2. Per ANSI/TIA 568 C.2 Section 6.2.2, DC resistance unbalance within a pair is not to exceed 200 m Ω or 3%, whichever is the greatest.
- G. DC Resistance Unbalance between Pairs
1. Shall be Reported DC resistance unbalance between pairs for the following pairs:

1,2-3,6	1,2-7,8	3,6-7,8
1,2-4,5	3,6-4,5	4,5-7,8
 2. DC resistance unbalance between pairs is not to exceed 200 m Ω or 7.5%, whichever is the greatest.
- H. Insertion Loss
1. Report both worst case and worst margins, in one direction, for all four pairs.
 2. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
 3. Insertion loss is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA 568 C.2 Section 6.3.7.
- I. Near-End Crosstalk (NEXT)
1. Report both worst case and worst margins in both directions for all pair combinations.

2. NEXT is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA 568 C.2 Section 6.3.8.
 3. Mark reported margins found to be within the accuracy of the field tester an asterisk (*).
 4. Store the time domain Xtalk data for any marginal or failing NEXT results.
- J. Power Sum Near-End Crosstalk (PS NEXT)
1. Report both worst case and worst margins in both directions for all four pairs.
 2. PS NEXT is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA 568 C.2 Section 6.3.9.
 3. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
 4. Store the time domain Xtalk data for any marginal or failing PS NEXT results.
- K. Attenuation Crosstalk Ratio Near-End (ACR-N)
1. Report both worst case and worst margins in both directions for all pair combinations.
 2. Record ACR-N for all twelve possible combinations.
- L. Power Sum Attenuation Crosstalk Ratio Near-End (PS ACR-N)
1. Report both worst case and worst margins in both directions for all four pairs.
 2. Record PS ACR-N for all eight possible combinations.
- M. Attenuation Crosstalk Ratio Far-End (ACR-F)
1. Report both worst case and worst margins in both directions for all 12 pair combinations.
 2. ACR-F is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA 568 C.2 Section 6.3.11.
 3. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
- N. Power Sum Attenuation to Crosstalk Ratio Far-End (PS ACR-F)
1. Report both worst case and worst margins in both directions for all four pairs.
 2. PS ACR-F is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA 568 C.2 Section 6.3.13.
 3. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).

- O. Return Loss
1. Report both worst case and worst margins in both directions for all four pairs.
 2. Ignore return loss at all frequencies where the insertion loss is less than 3 dB for that pair.
 3. Return loss is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA 568 C.2 Section 6.3.6.
 4. Mark reported margins found to be within the accuracy of the field tester with an asterisk (*).
 5. Store the time domain reflectometer data for any marginal or failing return loss results.
- P. Transverse Conversion Loss (TCL)
1. Report both worst case and worst margins in both directions for all four pairs.
 2. TCL is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA 568 C.2 Section 6.2.14.
- Q. Equal Level Transverse Conversion Transfer Loss (ELTCTL)
1. Report both worst case and worst margins in both directions for all four pairs.
 2. ELTCTL is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA 568 C.2 Section 6.2.16.
- R. Power Sum Alien Near-End Crosstalk (PS ANEXT)
1. The disturbed (victim) link shall have disturber links to the left and right of it and, if such links are present, above and below it.
 2. Disturber cables shall include all links within the same bundle as the disturbed (victim) link and adjacent links.
 3. If the link is patch-panel-to-patch-panel, then measure PS ANEXT in both directions. If the link is patch-panel-to-telecommunications-outlet, then measure PS ANEXT from the patch panel end only.
 4. PS ANEXT is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA 568 C.2 Section 6.3.21.
- S. Power Sum Alien Near-End Crosstalk (Average PS ANEXT)
1. Calculate average PS ANEXT by averaging the individual PS ANEXT loss values, in dB, for all four pairs in the disturbed (victim) link.
 2. PS ANEXT is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA 568 C.2 Section 6.3.22.
- T. Power Sum Alien Attenuation to Crosstalk Ratio Far-End (PS AACR-F)

1. PS AACR-F shall be the calculated power sum from all external pairs into the disturbed (victim) pair.
 2. The disturbed (victim) link shall have disturber links to the left and right of it and, if such links are present, above and below it.
 3. Disturber cables shall include all links within the same bundle as the disturbed (victim) link and adjacent links. If the link is patch-panel-to patch-panel, then measure PS AACR-F in both directions. If the link is patch-panel-to-telecommunications-outlet, then measure PS AACR-F from the patch panel end only.
 4. PS AACR-F is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA 568 C.2 Section 6.3.25
- U. Power Sum Alien Attenuation to Crosstalk Ratio Far-End (Average PS AACR-F)
1. Calculate Average PS AACR-F by averaging the individual PS AACR-F values, in dB, for all four pairs in the disturbed (victim) link.
 2. The disturbed (victim) link shall have disturber links to the left and right of it and, if such links are present, above and below it.
 3. Disturber cables shall include all links within the same bundle as the disturbed (victim) link and adjacent links.
 4. If the link is patch-panel-to-patch-panel, measure Average PS AACR-F in both directions. If the link is patch-panel-to-telecommunications-outlet, then measure Average PS AACR-F from the patch panel end only.
 5. Average PS AACR-F is not to exceed the limits for Category 6A permanent links specified in ANSI/TIA 568 C.2 Section 6.3.26.

3.07 TESTING OPTICAL FIBER CABLE

A. General

1. All tests performed on optical fiber cabling that use a laser or LED in a test set shall be carried out with in accordance with the safety precautions specified in ANSI Z136.2.
2. Prior to field-testing, fully assemble and label all outlets, cables, patch panels, and associated components. Any testing performed on incomplete systems shall be redone after the systems are fully assembled and labeled.
3. Use field test instruments that have the latest software and firmware installed.
4. Upon completion of each test, record the link and channel test results from the OLTS and OTDR in the test instrument for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.

5. Inspect fiber end faces using a video scope with a field of view of no less than 425 μm x 320 μm .
6. Record the end face images in the memory of the test instrument for subsequent uploading to a PC and reporting.
7. Perform testing on each cabling segment, connector to connector. Sampling is not acceptable.
8. Test the cabling using high-quality test reference cords that:
 - i. Are of the same core size as the cabling under test
 - ii. Are terminated with reference grade connectors that have a loss of no more than 0.1 dB for multi-mode and 0.2 dB for single-mode
 - iii. For OLTS testing, are between 2 m and 5 m long
 - iv. For multi-mode OTDR testing, have launch and tail fibers that are at least 100 m (328 feet) long
 - v. For single-mode testing, have launch and tail fibers of lengths appropriate for the link under test, as indicated in the following table:

<i>maximum length of link (km)</i>		<i>typical pulse width (ns)</i>	<i>minimum launch and tail cord length (m)</i>
<i>1310 nm</i>	<i>1550 nm only</i>		
0 to 35	0 to 50	= 1,000	130
35 to 45	50 to 65	3,000	400
45 to 50	65 to 75	10,000	1,000
= 50	= 75	20,000	2400

B. Optical Loss Testing for Horizontal and Backbone Links

1. Test multi-mode links in both directions at 850 nm and 1300 nm in accordance with ANSI/TIA-526-14-B, one-cord reference method, with an Encircled Flux compliant launch.
2. Single-mode backbone links shall be tested in both directions at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA 526 7, Method A.1 (the one-cord reference method).

C. Magnified End-Face Inspection

1. Inspect fibers using a video scope with a minimum field of view of 425 μm by 320 μm per IEC 61300-3-35 Edition 1.0.

2. Use the following test limits:
 - i. For multi-mode connectors, Table 6 of IEC 61300 3 35 Edition 1.0
 - ii. For single-mode field polished connectors, Table 5 of IEC 61300 3 35 Edition 1.0
 - iii. For single-mode factory polished connectors, Table 3 of IEC 61300 3 35 Edition 1.0
 - iv. For Angled Physical Contact (APC) connectors, Table 4 of IEC 61300 3 35 Edition 1.0
 3. Length Measurement
 - i. Record the length of each fiber.
 - ii. It is preferable that the optical length be measured using an OLTS or OTDR.
 4. Polarity Testing
 - i. Test paired duplex fibers in multi-fiber cables to verify that polarity is in accordance with Clause E.5.3 of ANSI/TIA 568 C.0.
 - ii. Verify the polarity of the paired duplex fibers using an OLTS.
- D. Manufacturer's Field Service
1. At the start of the installation, periodically as the Work progresses, and after completion, furnish:
 - i. The services of the manufacturer's technical representative at the job site, as needed, to advise on every phase of the Work
 - ii. Full-time attendance at least during the first three work days and at least once every week thereafter
 - iii. Technical assistance to the Installer as required.

3.08 FINAL TEST AND ADJUST

- A. The Contractor shall be responsible for post-installation performance testing of all cabling systems specified elsewhere in this Section of the Contract Documents.
1. Testing procedures shall permit recording the length of each link, theoretical loss budget, and tested parameters for each pair and fiber, including space for sign-off by General Contractor and Owner.
 2. Any cable links or fiber strands, which fail to meet performance test criteria, shall be re-terminated, re-connectorized, or replaced by the Contractor free of charge.

3. Submit final field test documentation in list form, including the General Contractor signature for Owner's approval.
- B. Unshielded Twisted–Pair Cable System Testing
1. Permanent Link Test Configuration: Perform metered tests on each multi–pair twisted–pair and/or four–pair UTP cable through the wiring block, patch panel, at each end of the cable section and/or telecommunication outlet (T.O.). The permanent link test shall be undertaken as described in ANSI/TIA 568.2-D.
 2. Performance Testing:
 - i. Horizontal Cable System:
 - a) Use a minimum Level IIIe field test instrument capable of the following swept/stepped frequency voltage measurements in accordance with the performance parameters required by ANSI/TIA 568.2-D
 - b) Test each horizontal link to verify/determine, wire map, length, attenuation, skew, and near–end–crosstalk (NEXT) as described in ANSI/TIA 568.2-D.
 - ii. Test Reports: Include field test results for each cable including cable link length in accordance with ANSI/TIA 568.2-D.
 - iii. The test summary shall include:
 - a) Cable Identification as it appears on cable schedule.
 - b) Cable identification as it appears on the individual test reports.
 - c) Cable identification as it is labeled in accordance to the Specifications.
 - d) Pass/Fail Status.
 - e) All test parameters shall appear on each test document including graphics and indicating each test parameter result.
 - f) The individual test data sheet shall include the automated printout produced by the cable scanning equipment.

END OF SECTION

SECTION 27 41 16

AUDIOVISUAL SYSTEMS

PART 1 — PART 1 - GENERAL

1.01 SUMMARY

- A. This section specifies the basic requirements for communications installations as indicated or required and includes requirements common to more than one specification section of this division such as:
1. Related documents.
 2. Related sections.
 3. Definitions.
 4. Governing requirements.
 5. Contractor requirements.
 6. Warranty requirements.
 7. Submittal requirements/procedures.
 8. Project closeout requirements/procedures, as well as other requirements).
 - i. This section may expand upon and/or supplement the requirements specified in Division 01.
 - ii. Examine the contract documents in their entirety (including drawings and specification sections in the other divisions) for requirements or work which may affect work under this section.
 - iii. Regardless of whether such requirements or work are specifically indicated in this section.
 - iv. Errors or Omissions in Drawings or Documentation
 9. If any errors or omissions appear in Drawings, Specifications, or other documents, the bidding Contractor shall notify the Engineer no later than ten (10) days prior to submitting the bid.
 10. Should conflict occur in or between Drawings and Specifications:
 - i. The bidding Contractor is deemed to have estimated the more expensive way of doing the work.
 - ii. Unless the bidding Contractor has asked for and obtained written decision (addendum) before submission of the bid as to which method or materials will be required.
- B. System Performance Requirements

C. Audio:

1. System shall have echo cancellation.
2. Conference audio shall be clear and without distortion on both ends and for phone participants. Outgoing audio shall be at an acceptable level to not cause discomfort.
3. Program audio system:
 - i. Frequency Response: 100 Hz to 12,000 Hz. 3 dB per octave roll off below 100Hz and above 12 kHz.
 - ii. Total Acoustical Harmonic Distortion: Less than 2% at 90 dBC (1 kHz reference) at four feet (1,220 mm) above finished floor in the middle of the room.
4. Distributed audio system:
 - i. Frequency Response: 125 Hz to 10,000 Hz. 3 dB per octave roll-off below 125 Hz and above 10 kHz.
 - ii. Total Acoustical Harmonic Distortion: Less than 2% at 85 dBC (1 kHz reference) at four feet (1,220 mm) above finished floor in the middle of the room.
5. Signal to noise ratio (mixer input to amplifier output): 75 dB from 50 Hz to 15 kHz minimum.
6. Frequency response with equalizers bypassed: less than ± 1 dB from 50 Hz to 12 kHz.
7. Distortion: less than 0.5% at 1 kHz at the equipment's rated input signal level.
8. Output levels (in audience areas without objectionable distortion, rattles, or buzzes, employing as test signals several different samples of recorded music and microphones applied at each system input):
 - i. Program audio: not less than 95 dB
 - ii. Speech reinforcement: not less than 85 dB
9. Hum and Noise: inaudible (below the background noise level of the space) under normal operation observed in audience areas.

D. Video:

1. System shall be capable of a minimum resolution of 1920 X 1080.
2. System shall be able to support the following resolutions: 1,280 x 720, 1,920 x 1,080, and 3840 X 2160.

3. Where beam forming devices are specified, configure PTZ camera tracking of speakers.
 4. Displays and projectors shall not have dead pixels, discoloring, or distortion.
- E. Wireless:
1. Wireless components shall not interfere with other systems.
 2. Components within a specified room shall not interfere with systems in another room
 3. Channels shall be coordinated so that wireless devices do not automatically connect to adjacent room/space's components.
- F. Control:
1. System shall not be capable of synchronization conflicts (i.e. alternate action (toggling) on/off without power reset or feedback).
 2. System shall be synchronized. A single component shall not receive multiple commands simultaneously.
 3. Volume memory shall be stored in between system ON and OFF. System reboots shall not set volume above 50%.
 4. Buttons shall be programmed with visible or colored status indicators.
 5. Physical and virtual buttons shall be operable.
 6. Configure system so that improper sequencing renders system unusable or with an infinite loop.
 7. Buttons on GUI shall not lead users to backend configuration or programming without proper permissions (i.e. pincode, or username/password).
 8. System sources shall roll-over in logical manner, and return to pre-programmed default.
 9. System shall be able to completely power cycle all components within room or space.
 10. Rooms with mobile credential control (i.e. smart phone, QR-code) shall not control adjacent rooms or space unless specified in 1.01.E.Room Types.
- G. Room Types:
1. Assisted listening system will be provided where required by Code.
 2. Office/Post Editing:
 - i. Boom microphone for recording
 - ii. Inputs for owner-provided camera system

- iii. Mixer and rack-mounted audio input/output panel
- 3. Office/Production & Media Room:
 - i. Control panel and SDI Hub for controlling reporting station SDI cameras/microphones
 - ii. Joystick and PTZ camera with input into SDI Hub
 - iii. Multiviewer for viewing controlled camera inputs and production edits
 - iv. Wireless and wired microphone system with audio amplification to ceiling loud speakers
 - v. In ear monitoring and 2-way wireless system for communications
 - vi. Replay editor and playback for editing content
 - vii. Control panel for room control, HDMI and USB-C inputs, encoder/decoder system for AV-over-IP
 - viii. In-room cabinet provided for equipment mounting
 - ix. Wireless presentation for BYOD conferencing and presentation
 - x. Clocks for viewing time
 - xi. 2x2 video wall and primary display for visual content sharing

1.02 DEFINITIONS

- A. "AHJ": Authority Having Jurisdiction
- B. "Connect": To install patch cords, equipment cords, crossconnect wire, etc. to complete and electronic or optical signal circuit.
- C. "Cord": a length of cordage having connectors at each end. The term "Cord" is synonymous with the term "Jumper" and "Lead".
- D. "Furnish": To purchase, procure, acquire, and deliver complete with related accessories.
- E. "ISP": Inside Plant
- F. "NEMA": National Electrical Manufacturers Association
- G. "OFCI": Owner-furnished contractor-installed; coordinate the integration of components furnished by the Owner; provide mounting hardware, cable, connectors, etc. to ensure proper integration of OFCI equipment.
- H. "OFE": Owner Furnished Equipment
- I. "OSP": Outside Plant

- J. “Provide”: To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation
- K. “Approved Grounding Point”: an approved grounding point is one that satisfies the applicable electrical code and provides a low impedance path to earth.
- L. Examples include the following though may manifest in different means: a telecommunications grounding busbar (such as for bonding an equipment rack within a telecom room).
- M. The ACEG of the electrical panel serving the equipment requiring bonding to ground (such as for bonding a credenza rack within a conference room), or the ground conductor of a branch circuit (such as for bonding a single piece of equipment).
- N. “Audience Area”: the portion of a presentation space intended to be occupied by an audience.
- O. An audience area includes the primary seating and standing spaces and may included the adjacent circulation spaces. An audience area generally excludes spaces reserved for presenters.
- P. “Audience Area”: the portion of a presentation space intended to be occupied by an audience.
- Q. An audience area includes the primary seating and standing spaces and may include the adjacent circulation spaces. An audience area generally excludes spaces reserved for presenters.
- R. “Custom” indicates systems or components the Contractor fabricates based on these specifications and drawings
- S. “EDID”: Extended display identification data
- T. “HDCP”: High-bandwidth digital content protection
- U. “HDMI”: High-definition multimedia interface
- V. “OFE”: Owner Furnished Equipment
- W. “RU”: rack unit, as defined in EIA/ECA-310
- X. “Shall” denotes a mandatory requirement
- Y. “Should” denotes an advisory statement
- Z. “SPL”: sound pressure level
- AA. “THD”: total harmonic distortion
- BB. “System”: The audiovisual components, cabling, and programming incorporated in the descriptions and equipment lists herein

1.03 REFERENCES

- A. Most recent editions, revisions, addenda, and bulletins of the following documents:
- B. ANSI/TIA–568 series
- C. ANSI/TIA–569 Telecommunications Pathways and Spaces
- D. ANSI/TIA–606 Administration Standard for Telecommunications Infrastructure
- E. ANSI/TIA–607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- F. ANSI/TIA–862 Structured Cabling Infrastructure Standard for Intelligent Building Systems
- G. Telecommunications Distribution Methods Manual
- H. Information Transport Systems Installation Methods Manual (ITSIMM)
- I. Americans with Disabilities Act
- J. National Electric Codes (NEC) – all applicable
- K. Local Codes and Standards – all applicable
- L. NFPA 70 – National Electrical Code
- M. NFPA 101 – Life Safety Code
- N. UL 969, “Marking and Labeling Systems”
- O. UL 1419, “Professional Video and Audio Equipment”
- P. UL 60065, “Audio, Video and Similar Electronic Apparatus – Safety Requirements”
- Q. InfoComm 1M, “Audio Coverage Uniformity in Enclosed Listener Areas”
- R. InfoComm 2M “Standard Guide for AV Systems Design and Coordination Processes”
- S. InfoComm 3M, “Projected Image System Contrast Ratio”
- T. InfoComm F501 01, “Cable Labeling for Audiovisual Systems”
- U. “Sound Systems Engineering”, 3rd Ed., Davis and Davis
- V. EIA/ECA-310, “Cabinets, Racks, Panels, and Associated Equipment”
- W. Local Authority Having Jurisdiction (AHJ)
- X. Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either
- Y. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor’s expense

1.04 QUALIFICATIONS

- A. The contractor shall hold a valid State of California C7 and C10 Contractor's license.
- B. Contractor shall have a proven track record in the field of specified cabling and system installations, with at least (3) previous installations of comparable size and complexity undertaken within the last (5) years.
- C. Contractor shall have advanced certifications (i.e. CTS-I, CTS-D).
- D. Contractor shall have manufacturer-specified advanced certifications for critical system components (i.e. DMC-D, XTP, etc.). Refer to Part 2.
- E. Contractor shall be a manufacturer's authorized distributor and warrantee station for the equipment offered, and shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment.

1.05 SUBMITTALS

- A. Make submittals in accordance with:
 - 1. Section 00 00 00 – Procurement and Contracting Requirements
 - 2. Section 01 33 00 – Submittal Procedures.
- B. Action Submittals:
 - 1. Shop Drawings
 - i. Owner will provide electronic files in CAD or Revit format, containing the contract document drawing files, for use in the preparing of the shop drawings, by the RCDD.
 - ii. Drawings will be to scale.
 - iii. Submit the following sheets:
 - a) Titlesheet and Cover Page: indicate project name and location; include sheet index
 - b) Overall Floor Plans: floor plans showing the locations of devices not within enlarged plans; devices and cable routing paths with cable types, quantity called out, and device IDs; rack locations; wall elevations of displays and projector screens; new pathways/conduits/boxes/etc.
 - c) Enlarged Plans: Floor and reflected ceiling plans showing the locations of devices and cable routing paths with cable types, quantity called out, and device IDs; rack locations; wall elevations of displays and projector screens; loudspeaker power; new pathways/conduits/boxes/etc.
 - d) Rough-in and wiring details. Include button panel layouts.

- e) Single line diagrams showing full scope of wiring and cabling between equipment, indicating Contractor and Owner scopes of work.

C. Product submittal

1. Contractor shall furnish products for a complete, turnkey system. Submit major components and ancillary accessories required for complete system.
2. Minor accessories like screws and nuts are not required for submission, unless specified in Part 2.
3. Product submittal shall be a single complete submittal. Incomplete submittals will be rejected without review.
4. Partial submittals will be allowed for short lead items only with documentation on lead time included at the front of the submittal.
5. Catalog cut sheets and data sheets containing physical and dimensional information, performance data, electrical characteristics, materials used in fabrication, material finish, and licenses.
6. Clearly indicate on each sheet what is being submitted on.
7. For touchscreen panels, submit separate PDFs per system with a page for each menu, submenu, and pop-up.
8. Submit Owner logos where required by Owner standards.
9. Qualification Data: Submit at least three references for projects similar in scope to the project described herein.
10. Include, for each customer reference, the following information: Company name, address, phone number, name and email address of contact and type of job completed.
 - i. Provide copies of the Contractor's certification.
 - ii. Provide written guarantees from manufacturers of major equipment, that a service representative has been assigned.
11. Provide copies of technician training certificates.
12. Submit test procedures for each room and standalone device. Group test procedures per room/standalone device. Refer to 1.01.D.System Performance Requirements for minimum requirements.
13. Cable and channel test documentation utilizing Merideo testing equipment.

1.06 CLOSEOUT DOCUMENTS

- A. Final close out documents including, but not limited to, test results on in digital PDF and physical CD-ROM or USB drive, in native tester format, project manual that includes manufacturer and contractor warranties, product cut sheets, material submittals, etc.
- B. Also, include the following:
- C. Provide "As-Built" Drawings in AutoCAD or Revit.
- D. "As-Built" drawings indicating location of all equipment including but not limited to outlets, patch panels, on each segment and cable routing outlet and identifiers. Indicate labeling for each piece of equipment.
- E. As-Built drawings will contain all installed cabling and materials. Outlets will be labeled with each cable associated with the work area outlet.
- F. Red-lined shop drawings submitted as As-built drawings will be rejected without review.
- G. (1) printed, hard copy of final approved as-built drawings in native sheet size will be provided to Owner. Unapproved sheet sizes will be rejected.
- H. Provide printed test reports in 3-ring binder and submit to Owner.
- I. Owner's written acceptance of installed systems.
- J. Print (2) printed copies of full-sized as-built drawings, and submit to Owner.
- K. Provide pricing and contact information for emergency service work not covered by warranty.

1.07 QUALITY ASSURANCE

- A. Standards for Materials and Equipment
 - 1. The Contractor shall provide all materials, equipment, and installation in compliance with the latest applicable standards from AVIXA, ANSI, FCC, ASTM, EIA/TIA, IEEE, NEC, NFPA, NEMA, OSHA, REA, and UL.
- B. Manufacturer's Warranty
 - 1. Warranty shall meet the following criteria:
 - i. This warranty will cover all cables, terminations, and components provided by the Contractor.
 - ii. Minimum 1-year written warranty covering workmanship and materials from the date of project completion. All repairs shall be made at no cost to the Owner during the warranty period.
 - iii. Corrections shall start within 48-hours of notification from Owner.
 - 2. If the warranty is needed by the Owner within the warranted period and the original installer is no longer in business, System manufacturer shall find a

substitute certified contractor and assume costs to fulfill the obligations of the warranty.

3. Upon acceptance of the warranty paperwork and test results from the Contractor, System manufacturer will mail a notification letter to the installer and a notification letter with warranty certificate to Owner.
4. The warranty period shall commence following the final acceptance of the project by Owner and written confirmation of warranty from System manufacturer.
5. Provide 5-year software service agreement.
6. Include associated licenses and renewal fees for the agreement's duration. Agreement and licenses shall commence following the project's substantial completion, and not the Contract's purchase date.

C. ACCEPTANCE TESTING

1. Provide tests specified below, when applicable or required by Owner, and as indicated under individual items of material, equipment, and work specified in this Specification.
 - i. Furnish all test equipment and instruments required for the tests.
 - ii. Responsible, qualified employees of the contractor in the presence of the Owner or an authorized representative shall perform the cable testing.
 - iii. All individuals involved in the testing phase of the project shall not have been involved in the installation phase nor shall have immediate knowledge of the installation task.
2. End-to-end performance and calibration of all parts and channels shall be tested prior to testing in presence of Engineer.
3. Performance testing of typical rooms and 1-of-each-kind of standalone systems shall be performed in presence of Engineer. System shall be accepted by Engineer prior to testing in presence of Owner.

- D. Performance testing of all rooms and standalone systems shall be performed in presence of Owner. Owner's written acceptance of system is a requirement of Closeout, and shall not conclude the Closeout Documentation stage.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. To prevent damage, theft, soiling, and misalignment, protect equipment during transit, storage, and handling
- B. The contractor shall coordinate the secure storage of equipment and materials on site, or, if no on-site storage is available, shall provide their own secure storage at the Contractor's expense.
 1. Do not store equipment where conditions fall outside the manufacturer's recommendations for environmental conditions.

2. Do not install damaged equipment. Remove environmental conditions from the site and replace damaged equipment with new equipment.
3. If off-site storage of materials is necessary, this shall be at the Contractor's expense.

1.09 PROJECT CONDITIONS

A. Project Environmental Requirements

1. Hazardous Materials Prohibition
2. The Contractor shall ensure that all materials used in the project are asbestos-free, unless specifically authorized in writing by the Owner.

B. Existing Conditions

1. Verify that all conditions on the project site are acceptable for the Work specified in this Section. Prior to bid opening, notify the Consulting Engineer, in writing, of any discrepancies, conflicts, or omissions. Otherwise, correct these issues at no additional cost to the Owner.
2. Continue to monitor the project site. If conditions develop that require a variance from the Specifications or Drawings, then immediately notify the Owner in writing.
3. Otherwise, make recommendations, submit drawings showing how the Work may be installed, and, upon approval, proceed with the necessary changes without additional cost to the Owner.

C. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, and work above ceilings is complete.

D. Confirmation of Pathway and Cable Manager sizing:

1. Wherever cabling pathways or managers are installed, it is the Contractor's responsibility to confirm pathway or manager sizing to represent no more than 25% fill upon installation according to manufacturer's fill tables.
2. Pathways deemed overfilled upon installation will not be accepted and shall be remedied at Contractor expense.

1.10 USE OF THE SITE

- A. Where the Owner deems it necessary to place restrictions, use the site as directed by the Owner.
- B. When proceeding with the work, do not interfere with the ordinary use of streets, aisles, passages, exits, or operations of the Owner. During the day, set up cones and barriers in hallways and walkways. Do not string cable down the hallways during normal hours.
- C. Request a hazardous materials worksheet that identifies potentially-hazardous locations. Do not proceed with any work in locations where hazardous materials are known to be.

- D. Obtain instructions from the Contractor's Project Manager on and when to work in these areas.
- E. Multiple times each day, each contractor shall remove all trash and debris from the site. Before leaving the room each day:
 - 1. The Contractor shall replace all ceiling tiles that they have removed.
 - 2. The Contractor shall place all furniture and equipment that they have moved back into its original location.
 - 3. The Contractor shall return any equipment that they have disconnected to working order.
 - 4. The Contractor's Job Foreman shall inspect all work locations to ensure that the rooms are clean and that all of the tasks described above have been done.
 - 5. It is recommended that the Contractor inspect the site and take pictures to document the condition of the ceilings and walls.
- F. RESPONSIBILITIES AND COORDINATION
- G. The Contractor shall provide all materials, qualified labor and services required to ensure a complete and operational system, installed in accordance with the intent of the Contract Documents.
- H. The Contractor shall furnish and install all incidental items not actually shown or specified, but which are required by best practices to provide complete functional systems.
- I. The Contractor shall coordinate the details of facility equipment and construction for all specification divisions, which affect the work covered under this Division
- J. The Contractor shall coordinate with all other trades. The Contractor will submit a schedule for the installation within 15 days of contract award.
 - 1. The schedule shall include delivery, installation, and testing for conformance to specific job completion dates.
 - 2. At minimum, the schedule shall provide dates for:
 - i. The start of demolition.
 - ii. The completion of demolition.
 - iii. The installation start date.
 - iv. The completion of copper cabling.
 - v. The completion of backbone cabling.
 - vi. The completion of testing and labeling, cutover.
 - vii. The completion of the final punch list, final inspection, and acceptance.

- K. The Contractor shall develop a bill of materials, perform material management and efficient use of the materials whether they are issued by Owner or purchased by the Contractor.
- L. The Contractor shall ensure materials, in excess of, those required to complete the project are kept in their original condition and packaging for restocking.
- M. The Contractor shall maintain existing cables and terminations not determined to be within the demolition scope of work.
- N. Cables damaged, removed, or unterminated shall be reinstalled and recertified with the manufacturer's certified installer, and test results provided to the Owner.

1.11 DESIGN CRITERIA

- A. Compliance by the contractor with the provisions of this Specification does not relieve him or she from the responsibilities of providing materials and equipment of proper design.
- B. Mechanically and electrically suited to meet operating requirements at the specified service conditions.

1.12 LABELING

- A. Refer to Owner's standards for labeling requirements.
- B. Comply with TIA/EIA-606-A, TIA/EIA-606-A, Addendum 1 and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Labeling: Provide labeling for audiovisual system components. The components include, but are not limited to, the following:
 - 1. Equipment racks and equipment enclosures
 - 2. Rack-mounted equipment and devices: Provide a label on the back of each piece of equipment.
 - 3. If a serial number (of a given piece of equipment) is not visible in a final installed condition, provide a label on the equipment on a visible location duplicating the serial number.
 - 4. Wall-mounted equipment and devices: Provide an equipment label on the back of each piece of equipment.
 - 5. If a serial number (of a given piece of equipment) is not visible in a final installed condition, provide a label on the equipment on a visible location duplicating the serial number.
 - 6. Wires and cables: Provide a cable label at each end of each piece of wire, cable, and cord.

7. Terminal blocks, patch panels, and other termination apparatus: Provide a label on each termination block, piece of termination apparatus and termination position on patch panels.
8. Handheld and wireless devices
9. User interfaces, devices, faceplates

PART 2 — PRODUCTS

2.01 GENERAL

- A. This Section includes General Requirements for each section in Division 27 and shall be used in conjunction with specifications, other related Divisions and related Contract Documents to establish the total requirements for the project.
- B. All materials and products shall be:
 1. Appropriate for the intended use
 2. Permitted by the Authority Having Jurisdiction (AHJ)
- C. All products shall be new, of the latest version at time of bid, and brought to the job site in original manufacturer's packaging. Used equipment and damaged material will be rejected.
- D. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.
- E. Take care during installation to prevent scratches, dents, chips, etc. Equipment with significant or disfiguring cosmetic flaws will be rejected.
- F. All components will be approved by the Engineer and shall have the most aesthetic value possible while maintaining specified functionality. Hardware shall:
 1. Be in compliance with the Construction Documents.
 2. Have fit and finish compatible with the existing surrounding structure.
 3. Be unobtrusive.
 4. Provide the required functionality.
- G. Fabricate custom-made equipment with careful consideration given to aesthetic, technical, and functional aspects of the equipment and its installation.
- H. Provide products that are suitable for the intended use, including, but not limited to environmental, regulatory, and electrical factors.
- I. Provide mounting brackets/attachments, transformers, additional accessories, and licenses for complete turnkey installation.

2.02 SUBSTITUTION POLICY

- A. Substitution of specified products or systems is not allowed.
- B. Contractor shall assume all costs for removal and replacement of any product installed in substitution of those specified. Such costs shall include but not be limited to labor, materials as well as any penalties, fees or costs incurred for late completion.

2.03 MANUFACTURERS

- A. Recording room equipment: Allen & Heath, Sennheiser
 - 1. Mixer:
 - i. SQ5
 - ii. SQ7
 - iii. or Qu-16 w/ Dante
 - 2. Audio Inputs/outputs:
 - i. DX168
 - ii. DX164-W
 - iii. or GX4816
 - 3. Microphone:
 - i. MKH-8018
- B. Media Room: PTZ Optics:
 - 1. Camera joystick: PT-JOY-G4
 - 2. PTZ Camera: Move 4K
- C. Production equipment: Black Magic Design
 - 1. Playback: UltraStudio 4K Mini
 - 2. Replay Editor: DaVinci Resolve Replay Editor
 - 3. SDI hub: Videohub 40x40 12G
 - 4. Multiviewer: MultiView 16
 - 5. Control panel: ATEM 2 M/E Advanced Panel 20
- D. Presentation equipment: Sennheiser, Crestron
 - 1. In ear monitor: XS Wireless
 - 2. 2- channel wireless microphone system: Profile Wireless
 - 3. Gooseneck microphone: MEG 14-40

4. Cip-on microphone: ME 4
 5. Wireless presentation: AirMedia 3
 6. Handheld Microphone: e 935
- E. Clock: American Time
1. 4", 6-digit, red display: 3WD461RSA
- F. Displays: LG, or equal
1. Transparent OLED
 - i. Video wall: 50"
 - ii. Production room: 30"
 - iii. Behind main lectern: 77"
- G. Display Mounts: Chief
- H. General AV: Crestron
1. Production room wall-mounted control panel: TSW-1070
 2. Lectern, wall, and production room inputs / encoder: DM-NVX-E20-2G
 3. AV-over-IP director: DM-NVX-DIR-80
 4. Decoder: DM-NVX-D30
 5. Encoder w/ HDMI and USB-C: DM-NVX-384
 6. Control processor: CP4
- I. Assisted Listening System:
1. Listen Tech
 2. Or equal

2.04 CABLING

- A. Provide cabling for complete, turnkey solution.
- B. Manufacturer:
 1. Belden
 2. Smartwire
 3. Or equal

PART 3 — EXECUTION

3.01 WORKMANSHIP

- A. Manufactured products, materials, equipment, and components shall be provided, conditioned, applied, installed, connected, and tested in accordance with the manufacturer's specifications and printed instructions.
- B. The installation of all system components shall be carried out under the direction of qualified personnel. Appearance shall be considered as important as mechanical and electrical efficiency. Workmanship shall meet or exceed industry standards.

3.02 INTENT OF DRAWINGS

- A. The Audiovisual drawings show only general locations of equipment, devices, raceways, cable trays, boxes, etc., unless specifically dimensioned.
- B. The Contractor shall be responsible for the proper placement and routing of equipment, cable, raceways, cable runway, and related components, according to the Contract Documents and subject to prior review by the Owner and structured cabling engineer.
- C. The Contractor shall refer any conflicts within the Contract Documents to the Construction Manager and/or Owner for resolution.

3.03 GROUNDING

- A. Comply with requirements in both 26 0526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI/TIA-607 and the local Electrical Code.

3.04 SERVICE CONTINUITY

- A. Maintain continuity of communications services to all functioning portions of the process or buildings during hours of normal use.
- B. Arrange temporary outages for cutover work with General Contractor. Keep outages to a minimum number and a minimum length of time in order to provide minimum impact.

3.05 LAYOUT AND TOLERANCES

- A. Follow as closely as practicable the schematic design shown on the drawings. Make all necessary measurements in the field to verify exact locations and ensure precise location and fit of specified items in accordance with the drawings. Make no substantial
- B. Alterations without prior approval of the owner and the engineer.

3.06 INSTALLATION

- A. Anchor and brace enclosures and cabinets where seismic bracing is required.
- B. Coordinate cooling for fully enclosed equipment (i.e. fans and vents for racks inside credenzas).
- C. Fully secure ceiling mounted equipment and raceways.

- D. Projection systems shall be aligned and adjusted for no distortion. Utilize physical and optical adjustments.
- E. Loudspeakers in series shall not exceed 75% of rated wattage.
- F. Provide service loops in backbox or nearest J-hook.
- G. Maintain signal and cable separation per Code and ANSI/BICS standards.
- H. Provide strain relief for cables and connectors.
- I. Configure EDID management for audio and video parameters are sent to source devices.
- J. Ensure HDCP is supported and working. HDCP may be disabled in educational institutions only for "fair use" conditions.
- K. Change passwords prior to final acceptance, and enable two-factor authentication.
- L. Ensure most current software is installed on devices and headend equipment.
- M. Coordinate GUI layout with Owner. Ensure button spacing is consistent and even.

3.07 CONSTRUCTION REVIEW

- A. The Engineer and Owner will review and observe installation work to ensure compliance by the contractor with requirements of the Contract Documents.
- B. Review, observation, assistance, and actions by the Engineer and Owner shall not be construed as undertaking supervisory control of the work or of methods and means employed by the contractor. The Engineer and Owner review and observation activities shall not relieve the contractor from the responsibilities of these Contract Documents.
- C. The fact that the Engineer and Owner does not make early discovery of faulty or omitted work shall not bar the Owner from subsequently rejecting this work and withholding payment until the contractor makes the necessary corrections.
- D. Regardless of when discovery and rejection are made, and regardless of when the contractor is ordered to correct such work, the contractor shall have no claim against the Engineer or Owner for an increase in the Subcontract price, or for any payment on account of increased cost, damage, or loss.

3.08 PROJECT RECORD DOCUMENTS

- A. Provide detailed project record documentation for sections listed in Part 1.
- B. Maintain separate sets of redlined record drawings, which show the exact placement, and identification of as-built system components. These are subject to weekly review by the General Contractor, Owner, or their representative.

3.09 ADDITIONAL CONTRACTOR REQUIREMENTS

- A. Contractor is responsible for the removal and disposal of all installation and construction debris created in the process of the job.

- B. All work areas will be cleaned at the conclusion of the project and no tools or materials shall be left in a manner as to pose a safety hazard.
- C. Projects are not considered finished and will not be paid by Owner until all debris, dust, etc. has been cleaned and removed to the Owner's satisfaction.
- D. Contractor shall remove all abandoned cable per Article 800 of the National Electrical Code and per TIA, BICSI, and AVIXA standards, recycling these materials where possible. Removal of orphaned cable is mandatory. Contractors shall consider this when placing bids.

3.10 FINAL ACCEPTANCE

- A. The Contractor is required to notify the Engineer/Owner of a proposed appointment for Final Inspection at least 72 hours before the appointment.
- B. Owner may visit site during construction to ensure installation is in compliance with their requirements. Punch items discovered by Owner shall be resolved within 10 days of discovery.
- C. System acceptance shall be defined as that point in time when the following requirements have been fulfilled:
 - 1. All submittals and documentation have been submitted, reviewed, and approved.
 - 2. The complete system has successfully completed all testing requirements.
 - 3. All punch list items have been corrected and accepted.

3.11 TRAINING

- A. Provide a minimum of (1) 8 hour training session with a minimum of (4) Owner's staff at the project site (or other location designated by the Owner) by a qualified instructor (presence of equipment manufacturer if needed for additional assistance). Topics shall include system usage, operation and maintenance, and minor modifications.

3.12 WARRANTY

- A. Maintenance
- B. Contractor shall perform preventative maintenance every (6) months after final completion.
- C. Contractor shall perform at a minimum:
 - 1. Cleaning of vents, filters, lenses
 - 2. Dust removal
 - 3. Projector readjustments
 - 4. System performance re-validation

- 5. Documentation of equipment requiring replacement (i.e. broken pixels/lenses/lamps, failing motors, etc.)
- D. Costs shall be provided for extended services not covered by warranty.

END OF SECTION

SECTION 28 00 00

COMMON WORK RESULTS FOR SECURITY

PART 1 — GENERAL

SUMMARY

This section specifies the basic requirements for Communications installations as indicated or required and includes requirements common to more than one specification section of this Division (such as related documents, related sections, definitions, governing requirements, contractor requirements, warranty requirements, submittal requirements/procedures, and project closeout requirements/procedures, as well as other requirements). This section may expand upon and/or supplement the requirements specified in Division 01.

Examine the contract documents in their entirety (including Drawings and Specification sections in the other divisions) for requirements or work which may affect work under this section, regardless of whether such requirements or work are specifically indicated in this section.

Errors or Omissions in Drawings or Documentation

If any errors or omissions appear in Drawings, Specifications, or other documents, the bidding Contractor shall notify the System Designer no later than ten (10) days prior to submitting the bid.

Should conflict occur in or between Drawings and Specifications, the bidding Contractor is deemed to have estimated the more expensive way of doing the work, unless the bidding Contractor has asked for and obtained written decision (addendum) before submission of the bid as to which method or materials will be required.

Related Sections:

Section 000000 – Procurement and Contracting Requirements

Section 010000 – General Requirements

Section 281000 – Access Control and Alarm Management System

DEFINITIONS

AES – Advanced Encryption Standard. ANSI – American Northern Standards Institute

AWG – American Wire Gauge

BICSI – Building Industry Consulting Service International

BLE – Bluetooth Low Energy

DHCP – Dynamic Host Configuration Protocol

DHS – Department of Homeland Security

DNS – Domain Name System

DPDT – Double Pole Double Throw

EIA – Electronics Industry Alliance

GUI – Graphical User Interface

Hazmat – Hazardous Materials

HTTP – Hypertext Transfer Protocol

IAM – Identity and Access Management

IDM – Identity Management

IEC – International Electrotechnical Commission

IEEE – Institute of Electrical and Electronic Engineers

IP – Internet Protocol

IPAC – Internet Protocol Access Control

ISO – International Standards Organization

KVM – Keyboard, Video (Monitor), Mouse

LAN – Local Area Network

NECA – National Electrical Contractors Association

NFC – Nearfield Communications

NFPA – National Fire Protection Agency

NIST – National Institute of Standards and Technology

NVR – Networked Video Recorder

PoE – Power over Ethernet

PTZ – Pan-Tilt-Zoom

SIA – Security Industry Association

SMS – Security Management System

SOC – Security Operations Center

SSH – Secure Shell

SSO – Single Sign-on

TIA – Telecommunications Industry Association

TLS – Transport Layer Security

UAS – Unmanned Aerial System

UL – Underwriters Laboratory

WAN – Wide Area Network

Provide: Furnish, install, terminate, label, test and certify a complete system.

Contract Documents (CD): Design drawings, specifications, sketches and schedules provided by the System Designer as they directly relate to this scope of work and this project.

NET–POP Rooms/MPOE (Main Point of Entry): The area where the outside plant media/carrier services appear in the facility. The NET–POP contains equipment used by owner or carrier to hand–off/transition cable from outside plant into inside plant type.

Network Center/Main Distribution Frame (MDF) Areas: This technology space houses Layer 2/3 network switching gear and other main network distribution equipment and acts as the mid–connection point between the Core/Network and the TR/IDF/access zones for all connections.

Telecommunications Room (TR)/Intermediate Distribution Frame (IDF): is the location for the termination of backbone cables and for termination of horizontal cables, and for the interconnection of each. The space also hosts access–layer switches and user network connections within each floor.

Active Equipment: electronic equipment used to develop various WAN, LAN, and voice services, e.g., digital multiplexers, RS–232 controllers, Ethernet hubs, switches, routers, PBX, etc.

Horizontal: cabling system consisting of media and termination hardware interconnecting the Telecommunication Outlets (TOs) and the TRs.

Bonding: permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and the capacity to conduct safely any current likely to be imposed on it.

Cable Tray: vertical or horizontal open supports, usually made of aluminum or steel, which are fastened to the building structure. Cables are laid in and fastened to the trays.

Cabinet: free standing, floor–mounted or wall–mounted modular enclosure designed to house and protect rack–mounted electronic equipment and passive terminations.

Channel: The end–to–end transmission path between two points at which application specific equipment is connected; encompasses all the elements of the horizontal cabling link, plus the equipment cords in the telecommunications spaces and work area.

Grounding: a conducting connection to earth, or to some conducting body that serves in place of earth.

Jack: receptacle used in conjunction with a plug to make electrical contact between communications circuits, e.g., eight–position/eight–contact modular jacks.

Media: twisted–pair/fiber optic cable or cables, or other forms of transmission used to provide signal paths.

Outside Plant (OSP): generally, any and all portions of the cable system that runs outside of an environmentally enclosed structure and/or building with each end terminated at different buildings. This specifically includes inter–building cables, conduits, manholes, hand–holes, and innerduct.

UTP: Unshielded Twisted Pair.

Passive Equipment: non–electronic hardware and apparatus, e.g., equipment racks, cable trays, electrical protection, patch panels, wiring blocks, fiber optic shelves, etc.

Patch Cords: a length of wire or fiber cable with connectors on one or both ends used to join communications circuits at a cross–connect.

Patch Panel: system of terminal blocks or connectors used with patch cords that facilitate administration of cross–connect fields.

Pathway: facility for the placement of communications cable. A pathway facility can be composed of several components including conduit, wireway, cable tray, surface raceway, under floor systems, overhead systems, raised floor, ceiling support wires, etc.

Protectors: electrical protection devices used to limit foreign voltages on metallic communications circuits.

Raceway: an enclosed channel designed expressly for holding wires or cables; may be of metal or insulating material. The term includes conduit, tubing, wire ways, under floor raceways, overhead raceways and surface raceways; does not include cable tray.

Racks: An open, freestanding, floor–mounted structure, typically made of aluminum or steel, used to mount equipment; usually referred to as an equipment rack.

Wireway: An enclosure with removable lid whose purpose is for routing cable and storing cable slack.

Contractor – The successful bidder engaged to provide the work of this specification

Access Control and Alarm Management System (ACAMS): System whose primary function is to control access through building via credentials, credential management, and electrified locking hardware. It's secondary function is to provide alarm monitoring and management for various sensors associated with access control breaches throughout the building.

Video Surveillance System (VSS): System whose primary function is video recording and storage of select areas in or around the building. The VSS is forensic in nature and is managed by the VMS.

Video Management System (VMS): System application that manages viewing and forensic analysis of VSS video feeds.

Intrusion Detection System (IDS): System whose primary function is the monitoring and management of alarms associated with breaches through a secured building or perimeter.

Perimeter Intrusion Detection System (PIDS): System whose primary function is the detection, tracking, monitoring, and management of alarms associated with breaches from an external perimeter to a secondary or exterior boundary.

Visitor Management System: System whose primary function is to provide temporary access credentials for entry through specified access-controlled portals. This system is integrated with the ACAMS.

Antipassback: Antipassback controls are intended to prevent an authorized user from bypassing access control for another individual, by passing back an access credential (card or mobile device) after using it to allow an accompanying individual to present the same credential and gain access.

Application Programming Interface (API): Documented set of definitions and protocols for developing integrations between networked software applications, including software running on IoT devices.

Availability Zones: Physically separate datacenter locations within each data center geographical region that are tolerant to local failures. Failures can range from software and hardware failures to events such as earthquakes, floods, and fires. Availability zones must be designed so that if one zone is affected, cloud services, capacity, and high availability are fully supported by at least two other zones within the geographical region.

Biometric: Unique identifying physical or physiological characteristic of an individual that can be used to identify that individual, such as a facial image or fingerprint.

BUS: Short for communication bus, a collection of wires forming a communication system that transfers data between components inside a computer, or between computers.

CAN BUS: Controller area network (CAN) communication bus standard designed to allow microcontrollers and devices to communicate with each other's applications without a host computer.

Cloud-Native Software: Web application developed specifically for deployment as a cloud service, designed per the NIST five essential characteristics of cloud computing.

Container: A discrete computing environment for running software code, typically set up with only those parts of an operating system and other code libraries that are necessary for the software code to run correctly. A container may hold a complete application, a set of software functions, or a single function that performs just one task – such as responding to an access control system event. Each container is autonomous, can be launched in milliseconds, and runs in its own isolated environment, ensuring it does not disrupt other running applications or its underlying system. For example, in a physical access control cloud application supporting tens of millions of users and millions of card reader events per day, parallel processing using containers is a critical element of high performance.

Credential: Piece of information, usually digital, which serves as a means of identifying a user to an access control system for the purposes of authenticating the user and determining what that user's permissions are within the system. In a physical access control system, credentials are typically PIN codes, smart card encoded values, biometric data, mobile credentials, etc.

Destination Dispatch: Destination dispatch is an optimization technique used for multi-elevator installations, in which groups of passengers heading to the same destinations use the same elevators, thereby reducing waiting and travel times. Using destination dispatch, passengers request travel to a particular floor using a keypad, touch screen, or electronic credential prior in the lobby and are immediately directed to an appropriate elevator car.

Digital Certificate: Electronic document, issued by a Certificate Authority, for uniquely identifying a party (such as a software application or hardware device) in a networked communication session.

General Data Protection Regulation (GDPR): Regulation in European Union (EU) law on data protection and privacy in the EU and the European Economic Area (EEA). It also addresses the transfer of personal data outside the EU and EEA areas.

IOT-Native Device: Networkable cybersecure device specifically engineered to operate independently and communicate via local network and/or continuous, periodic or ad-hoc Internet connection.

LEAF Consortium: Association of industry manufacturers whose purpose is to foster interoperability in the access control and identity credentials markets.

National Institute of Standards and Technology (NIST): U.S. federal technology agency that works with industries to develop and apply technology, measurements, and standards.

Principle of Least Privilege: Information security concept in which a user is given the minimum levels of access – or permissions – needed to perform the user's job functions.

Representational State Transfer (REST): Set of architectural guidelines for the design and development of HTTP-based communications between computer systems on the web.

Reader: One of the several types of devices, mounted at a facility door or gate, or in an elevator cab or elevator lobby, which serves as an input device for credentials such as smartcards, PIN codes, biometrics, mobile credentials, etc.

RESTful API: API that conforms to the constraints of REST architectural guidelines.

Serverless: Serverless is a cloud-native development model that allows developers to build and run applications without having to manage individual virtual or physical servers directly, which are managed by the cloud service provider, chiefly through highly cost-effective automation. Serverless apps may be deployed in containers (see definition above) that automatically launch on demand when called.

Single Sign-On (SSO): Single Sign-On occurs when a user logs in (signs on) to one application or system, and is then automatically logged in to other applications or systems during the same session, regardless of the application, system, domain or network the user accesses during the session.

System Administrator: Individual who has the ability to login to an account and, based on assigned roles, view or change account information and perform manual access control actions.

User: Individual to whom a system access credential is provided that the access control system uses to perform authentication of the user and provide authorized access.

X.509:Standard for a public key infrastructure (PKI) to manage digital certificates and public-key encryption.

REFERENCES

Most recent editions, revisions, addenda, and bulletins of the following documents:

ANSI/TIA–568 series

ANSI/TIA–569 Telecommunications Pathways and Spaces

ANSI/TIA–606 Administration Standard for Telecommunications Infrastructure

ANSI/TIA–607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

ANSI/TIA–862 Structured Cabling Infrastructure Standard for Intelligent Building Systems

Telecommunications Distribution Methods Manual

Information Transport Systems Installation Methods Manual (ITSIMM)

Americans with Disabilities Act

California Electric Codes (CEC)

Local Codes and Standards – all applicable

NFPA 70 – National Electrical Code

NFPA 72 – National Fire Alarm and Signaling Code

NFPA 101 – Life Safety Code

NFPA 730 – Guide for Premises Security

NFPA 731 – Standard for the Installation of Electronic Premises Security Systems

NFPA 780 – Standard for the Installation of Lightning Protection Systems

NFPA 1982 – Standard on Personal Alert Safety Systems

UL444 – Standard for Safety of Communications Cable

UL 96 – Installation Requirements for Lightning Protection Systems

UL 294 – Standard for Access Control System Units

UL 365 – Police Station Connected Burglar Alarm Units and Systems

UL 603 – Standard for Power Supplies for Use with Burglar-Alarm Systems

UL 681 – Standard for Installation and Classification of Burglar and Holdup Alarm Systems

UL 827 – Standard for Central-Station Alarm Services

UL 1034 – Standard for Burglary-Resistant Electric Locking Mechanisms

UL 1666 – Standard for Safety of Flame Propagation Height

UL 1076 – Standard for Proprietary Burglar Alarm Units and Systems

UL 1610 – Standard for Central-Station Burglar-Alarm Units

UL 2610 – Commercial Premises Security Alarm Units and Systems

Local Authority Having Jurisdiction (AHJ)

Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either

Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense

QUALIFICATIONS

The Contractor shall hold a valid State of California C7 and C10 Contractor's license.

Contractor shall have a proven track record in the field of specified system installations, with at least (3) previous installations of comparable size and complexity undertaken within the last (5) years.

Contractor shall be a manufacturer's authorized distributor and warrantee station for the equipment offered, and shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment.

SUBMITTALS

Make submittals in accordance with:

Section 00 00 00 – Procurement and Contracting Requirements

Section 01 33 00 – Submittal Procedures.

Action Submittals:

Shop Drawings

Owner will provide electronic files in CAD or Revit format, containing the contract document drawing files, for use in the preparing of the shop drawings.

Drawings will be to scale.

Submit the following sheets:

Titlesheet and Cover Page: indicate project name and location; include sheet index

Site Plan

Overall Floor Plans: floor plans showing the locations of devices and cable routing paths with cable types, quantity called out, and device IDs; headend locations; cable routes; new pathways/conduits/boxes/etc.

Alarm zone schedule indicating protected areas.

Enlarged Plans: Headend rooms with equipment types and quantity called out; coordinated wall elevations; rack elevations; CFCI and OFCI equipment called out.

Panel schedules or risers: Show all devices connected to headend equipment ports; devices IDs; interconnections between all boards, power supplies, batteries, relays, etc.

Rough-in and wiring details.

Calculations: longest cable voltage drop per headend location; battery storage calculations; video storage calculations; power calculations per circuit per headend location for peak and average power; pixel density calculations for expected camera field of view where specified

Product submittal

Contractor shall furnish products for a complete, turnkey system. Submit major components and ancillary accessories required for complete system. Minor accessories like screws and nuts are not required for submission, unless specified in other Specifications sections.

Product submittal shall be a single complete submittal. Incomplete submittals will be rejected without review.

Partial submittals will be allowed for short lead items only with documentation on lead time included at the front of the submittal.

Catalog cut sheets and data sheets containing physical and dimensional information, performance data, electrical characteristics, materials used in fabrication, material finish, and licenses. Clearly indicate on each sheet what is being submitted on.

Qualification Data: Submit at least three references for projects already completed, similar in scope to the project described herein. Include, for each customer reference, the following information: Company name, address, phone number, name and email address of contact and type of job completed.

Provide copies of the Contractor's certification.

Provide written guarantees from manufacturers of major equipment, that a service representative has been assigned.

Provide copies of technician training certificates.

Submit test procedures for each door and standalone device.

Acceptance testing submittal

Installer shall provide a test plan including system acceptance inspections and test demonstrations to be jointly performed by Installer and Owner. Owner shall designate personnel to observe and/or perform test steps as agreed with Installer.

Include the following verifications in the test plan:

OSDP-shall be enabled where specified.

Contractor may use manufacturer's commissioning journals where available to create testing plan.

CLOSEOUT DOCUMENTS

Final close out documents including, but not limited to, test results on in digital PDF and physical CD-ROM or USB drive, in native tester format, project manual that includes manufacturer and contractor warranties, product cut sheets, material submittals, etc. Also, include the following:

Provide "As-Built" Drawings in AutoCAD or Revit.

"As-Built" drawings indicating location of all equipment including but not limited to devices, headend equipment locations, wall elevations, cable routes, identification/labels, custom wiring, etc.

Include modifications of existing systems

Red-lined shop drawings submitted as As-built drawings will be rejected without review.

(1) printed, hard copy of final approved as-built drawings in native sheet size will be provided to Owner. Unapproved sheet sizes will be rejected.

Spreadsheet of the following:

ACAMS

Panel/enclosure identification

IP and MAC address(es) for each panel

Location of each panel

Patch panel and switch ports each panel is connected to

Owner's written acceptance of installed systems.

Print (2) printed copies of full-sized as-built drawings, and submit to Owner.

Provide pricing and contact information for emergency service work not covered by warranty.

QUALITY ASSURANCE

Standards for Materials and Equipment

The Contractor shall provide all materials, equipment, and installation in compliance with the latest applicable standards from ASIS, ANSI, FCC, ASTM, EIA/TIA, IEEE, NEC, NFPA, NEMA, OSHA, REA, and UL.

Acceptance Testing

Verify by inspection and formalize by signed-off inspection documentation that system installation has been performed as specified.

Execute test plan and formalize by documentation sign-off that system performance has been demonstrated to the satisfaction of Owner. Owner's Representative retains right to suspend and/or terminate testing at any time upon failure of the system to perform as specified. Owner's written acceptance of system is a requirement of Closeout, and shall not conclude the Closeout Documentation stage.

Collaborate with Owner's Representative prior to start of testing, to establish criteria pass/fail criteria and classification of test execution problems, such as:

Pass/fail: Criteria determining what constitutes a test pass or failure.

Suspension and resumption: Criteria determining when testing must be suspended and resulted later.

Show Stopper: Stop test, fix problem and restart test from beginning.

Major Problem: Fix problem before test can be resumed or concluded.

Minor Problem: Add problem to "punch list", complete test.

Special Issue: Investigate to determine which problem category above category applies.

Provide tests specified below, when applicable or required by Owner, and as indicated under individual items of material, equipment, and work specified in this Specification.

Furnish all test equipment and instruments required for the tests.

Responsible, qualified employees of the contractor in the presence of the Owner or an authorized representative shall perform the cable testing.

All individuals involved in the testing phase of the project shall not have been involved in the installation phase nor shall have immediate knowledge of the installation task.

End-to-end performance and calibration of all parts and channels shall be tested prior to testing in presence of System Designer.

Performance testing of randomly-selected doors and standalone devices shall be performed in presence of System Designer. System shall be accepted by System Designer prior to testing in presence of Owner.

WARRANTY & SUPPORT

Warranty

Warranty shall meet the following criteria:

This warranty will cover all cables, terminations, and components provided by the Contractor.

Minimum 1-year written warranty covering workmanship and materials from the date of project completion. All repairs shall be made at no cost to the Owner during the warranty period.

Corrections shall start within 48-hours of notification from Owner.

If the warranty is needed by the Owner within the warranted period and the original installer is no longer in business, System manufacturer shall find a substitute certified contractor and assume costs to fulfill the obligations of the warranty.

Upon acceptance of the warranty paperwork and test results from the Contractor, System manufacturer will mail a notification letter to the installer and a notification letter with warranty certificate to Owner.

The warranty period shall commence following the final acceptance of the project by Owner and written confirmation of warranty from System manufacturer.

Provide 5-year software service agreement. Include associated licenses and renewal fees for the agreement's duration. Agreement and licenses shall commence following the project's substantial completion, and not the Contract's purchase date.

Manufacturer Support:

For the duration of the System subscription, automatically provide documented feature and security updates to cloud-based System software and Mobile Apps at no additional charge. Software, Mobile App and firmware updates shall be provided on a continuous basis.

Provide direct live telephone technical support free of charge both to end users and installing/maintaining security services contractors.

Provide optional additional-cost professional services for on-site deployment support to installing/maintaining services firm.

Maintenance and Service: Servicing Contractor shall:

General Requirements:

Provide all services required and equipment necessary to maintain the entire integrated electronic security system in an operational state as specified for a period of one year after formal written acceptance of the system. Provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Minimize impacts on facility operations when performing scheduled adjustments or other non-scheduled work.

Description of Work:

Provide adjustment and repair of the Cloud-Based Physical Access Control System on-site equipment consistent with Manufacturer guidance and instructions.

Personnel:

Ensure service personnel are certified in the maintenance and repair of the selected type of equipment and qualified to accomplish all work promptly and satisfactorily.

Schedule of Work:

Perform work during regular working hours, Monday through Friday, excluding federal holidays.

Emergency Service:

Provide staffed emergency service center service 24 hours a day 365 days a year. Provide emergency service center telephone number for the Owner to request service when system is not functioning properly. Owner has sole authority for determining catastrophic and non-catastrophic system failures within parameters stated in General Project Requirements.

For catastrophic system failures, provide same day four-hour service response with a defect correction time not to exceed eight hours from notification. Catastrophic system failures are defined as any system failure that Owner determines will place the security of one or more sites at increased risk.

For non-catastrophic failures, provide eight-hour service response with a defect correction time not to exceed 24 hours from notification.

Operation:

In performance of scheduled adjustments and repair, at completion of work document the following:

For routine maintenance, briefly describe the work done.

For problem resolution, describe the problem, the troubleshooting work done, root cause discovered, and remedial action taken.

Verify operation of the system relative to any changes, repairs or part replacements made.

DELIVERY, STORAGE, AND HANDLING

To prevent damage, theft, soiling, and misalignment, protect equipment during transit, storage, and handling

The contractor shall coordinate the secure storage of equipment and materials on site, or, if no on-site storage is available, shall provide their own secure storage at the Contractor's expense.

Do not store equipment where conditions fall outside the manufacturer's recommendations for environmental conditions.

Do not install damaged equipment. Remove environmental conditions from the site and replace damaged equipment with new equipment.

If off-site storage of materials is necessary, this shall be at the Contractor's expense.

PROJECT CONDITIONS

Project Environmental Requirements

Hazardous Materials Prohibition

The Contractor shall ensure that all materials used in the project are asbestos-free, unless specifically authorized in writing by the Owner.

Existing Conditions

Verify that all conditions on the project site are acceptable for the Work specified in this Section. Prior to bid opening, notify the System Designer, in writing, of any discrepancies, conflicts, or omissions. Otherwise, correct these issues at no additional cost to the Owner.

Continue to monitor the project site. If conditions develop that require a variance from the Specifications or Drawings, then immediately notify the Owner in writing. Otherwise, make recommendations, submit drawings showing how the Work may be installed, and, upon approval, proceed with the necessary changes without additional cost to the Owner.

Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, and work above ceilings is complete.

Confirmation of Pathway and Cable Manager sizing:

Wherever cabling pathways or managers are installed, it is the Contractor's responsibility to confirm pathway or manager sizing to represent no more than 25% fill upon installation according to manufacturer's fill tables.

Pathways deemed overfilled upon installation will not be accepted and shall be remedied at Contractor expense.

USE OF THE SITE

Where the Owner deems it necessary to place restrictions, use the site as directed by the Owner.

When proceeding with the work, do not interfere with the ordinary use of streets, aisles, passages, exits, or operations of the Owner. During the day, set up cones and barriers in hallways and walkways. Do not string cable down the hallways during normal hours.

Request a hazardous materials worksheet that identifies potentially-hazardous locations. Do not proceed with any work in locations where hazardous materials are known to be. Obtain instructions from the Contractor's Project Manager on and when to work in these areas.

Multiple times each day, each contractor shall remove all trash and debris from the site. Before leaving the room each day:

The Contractor shall replace all ceiling tiles that they have removed.

The Contractor shall place all furniture and equipment that they have moved back into its original location.

The Contractor shall return any equipment that they have disconnected to working order.

The Contractor's Job Foreman shall inspect all work locations to ensure that the rooms are clean and that all of the tasks described above have been done.

It is recommended that the Contractor inspect the site and take pictures to document the condition of the ceilings and walls.

RESPONSIBILITIES AND COORDINATION

The Contractor shall provide all materials, qualified labor and services required to ensure a complete and operational system, installed in accordance with the intent of the Contract Documents.

The Contractor shall furnish and install all incidental items not actually shown or specified, but which are required by best practices to provide complete functional systems.

The Contractor shall coordinate the details of facility equipment and construction for all specification divisions, which affect the work covered under this Division.

The Contractor shall coordinate all activities with the overall construction schedule.

The Contractor shall coordinate with all other trades. The Contractor will submit a schedule for the installation within 15 days of contract award.

The schedule shall include delivery, installation, and testing for conformance to specific job completion dates.

At minimum, the schedule shall provide dates for the start of demolition, the completion of demolition, the installation start date, the completion of copper cabling, the completion of backbone cabling, the completion of testing and labeling, cutover, the completion of the final punch list, final inspection, and acceptance.

The Contractor shall develop a bill of materials, perform material management and efficient use of the materials whether they are issued by Owner or purchased by the Contractor.

The Contractor shall ensure materials, in excess of, those required to complete the project are kept in their original condition and packaging for restocking.

The Contractor shall maintain existing cables and terminations not determined to be within the demolition scope of work. Cables damaged, removed, or unterminated shall be reinstalled and recertified with the manufacturer's certified installer, and test results provided to the Owner.

DESIGN CRITERIA

Compliance by the contractor with the provisions of this Specification does not relieve him or she from the responsibilities of providing materials and equipment of proper design, mechanically and electrically suited to meet operating requirements at the specified service conditions.

LABELING

Refer to Owner's standards for labeling requirements.

Comply with TIA/EIA-606-A, TIA/EIA-606-A, Addendum 1 and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 2 — PRODUCTS

GENERAL

This Section includes General Requirements for each section in Division 28 and shall be used in conjunction with specifications, other related Divisions and related Contract Documents to establish the total requirements for the project.

All materials and products shall be:

Appropriate for the intended use

Permitted by the Authority Having Jurisdiction (AHJ)

All products shall be new, of the latest version at time of bid, and brought to the job site in original manufacturer's packaging. Used equipment and damaged material will be rejected.

Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

Take care during installation to prevent scratches, dents, chips, etc. Equipment with significant or disfiguring cosmetic flaws will be rejected.

All components will be approved by the System Designer and shall have the most aesthetic value possible while maintaining specified functionality. Hardware shall:

Be in compliance with the Construction Documents.

Have fit and finish compatible with the existing surrounding structure.

Be unobtrusive.

Provide the required functionality.

Fabricate custom-made equipment with careful consideration given to aesthetic, technical, and functional aspects of the equipment and its installation.

Provide products that are suitable for the intended use, including, but not limited to environmental, regulatory, and electrical factors.

Provide Torx screws for all devices specified in technical sections. Additionally, provide Torx screws for pathways associated with devices specified in technical sections below 10' AFF.

SUBSTITUTION POLICY

Substitution of specified products or systems is not allowed.

Contractor shall assume all costs for removal and replacement of any product installed in substitution of those specified. Such costs shall include but not be limited to labor, materials as well as any penalties, fees or costs incurred for late completion.

PART 3 — EXECUTION

WORKMANSHIP

Manufactured products, materials, equipment, and components shall be provided, conditioned, applied, installed, connected, and tested in accordance with the manufacturer's specifications and printed instructions.

The installation of all system components shall be carried out under the direction of qualified personnel. Appearance shall be considered as important as mechanical and electrical efficiency. Workmanship shall meet or exceed industry standards.

INTENT OF DRAWINGS

The Security drawings show only general locations of equipment, devices, raceways, cable trays, boxes, etc., unless specifically dimensioned.

The Contractor shall be responsible for the proper placement and routing of equipment, cable, raceways, cable runway, and related components, according to the Contract Documents and subject to prior review by the Owner and System Designer.

The Contractor shall refer any conflicts within the Contract Documents to the Construction Manager and/or Owner for resolution.

GROUNDING

Comply with requirements in both 26 0526 "Grounding and Bonding for Electrical Systems" and 28 0526 "Grounding and Bonding for Security Systems" for grounding conductors and connectors.

Comply with ANSI/TIA-607 and the local Electrical Code.

SERVICE CONTINUITY

Maintain continuity of communications services to all functioning portions of the process or buildings during hours of normal use.

Arrange temporary outages for cutover work with General Contractor. Keep outages to a minimum number and a minimum length of time in order to provide minimum impact.

LAYOUT AND TOLERANCES

Follow as closely as practicable the schematic design shown on the drawings. Make all necessary measurements in the field to verify exact locations and ensure precise location and fit of specified items in accordance with the drawings. Make no substantial alterations without prior approval of the Owner and the System Designer.

CONSTRUCTION REVIEW

The System Designer and Owner will review and observe installation work to ensure compliance by the contractor with requirements of the Contract Documents.

Review, observation, assistance, and actions by the System Designer and Owner shall not be construed as undertaking supervisory control of the work or of methods and means employed by the contractor. The System Designer and Owner review and observation activities shall not relieve the contractor from the responsibilities of these Contract Documents.

The fact that the System Designer and Owner does not make early discovery of faulty or omitted work shall not bar the Owner from subsequently rejecting this work and withholding payment until the contractor makes the necessary corrections.

Regardless of when discovery and rejection are made, and regardless of when the contractor is ordered to correct such work, the contractor shall have no claim against the System Designer or Owner for an increase in the Subcontract price, or for any payment on account of increased cost, damage, or loss.

PROJECT RECORD DOCUMENTS

Provide detailed project record documentation for sections listed in Part 1.

Maintain separate sets of redlined record drawings for the communications work, which show the exact placement, and identification of as-built system components. These are subject to weekly review by the General Contractor, Owner, or its representative.

ADDITIONAL CONTRACTOR REQUIREMENTS

Contractor is responsible for the removal and disposal of all installation and construction debris created in the process of the job.

All work areas will be cleaned at the conclusion of the project and no tools or materials shall be left in a manner as to pose a safety hazard.

Projects are not considered finished and will not be paid by Owner until all debris, dust, etc. has been cleaned and removed to the Owner's satisfaction.

Contractor shall remove all abandoned cable per Article 800 of the National Electrical Code and per TIA, BICSI, and ASIS standards, recycling these materials where possible. Removal of orphaned cable is mandatory. Contractors shall consider this when placing bids.

FINAL ACCEPTANCE

The Contractor is required to notify the System Designer and Owner of a proposed appointment for Final Inspection at least 72 hours before the appointment.

Owner may visit site during construction to ensure installation is in compliance with their requirements. Punch items discovered by Owner shall be resolved within 10 days of discovery.

System acceptance shall be defined as that point in time when the following requirements have been fulfilled:

All submittals and documentation have been submitted, reviewed, and approved.

The complete system has successfully completed all testing requirements.

All punch list items have been corrected and accepted.

WARRANTY

Maintenance

Contractor shall perform preventative maintenance every (6) months after final completion.

Contractor shall perform at a minimum:

System performance re-validation

Documentation of equipment requiring replacement (i.e. broken lenses/domes, broken locks, loose handles, etc.)

Costs shall be provided for extended services not covered by warranty.

END OF SECTION

SECTION 28 10 00

ACCESS CONTROL AND ALARM MANAGEMENT SYSTEM

PART 1 — GENERAL

1.01 SUMMARY

A. Contractor Shall Provide and Install

1. The materials and labor required for the installation of access control and alarm management systems include, but are not limited to:
 - i. Access control panels and enclosures
 - ii. Power supplies and enclosures
 - iii. Credential readers
 - iv. Request-to-exit devices
 - v. Electrified locksets
 - vi. Through-wire electrified transfer hinges
 - vii. Door contacts
 - viii. End-of-line resistors
 - ix. Cabling
2. Although such work is not specifically mentioned herein or on the Drawings, the Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, without claim for additional payment.

B. Related Sections:

1. Section 000000 – Procurement and Contracting Requirements
2. Section 010000 – General Requirements
3. Section 280000 – Common Work Results for Security
4. Section 282000 – Video Surveillance System

1.02 SYSTEM DESCRIPTION

A. Access Control and Alarm Management System (ACAMS)

1. An access control system will be provided to facilitate access through Owner-designed portals via credential readers, electrified locksets, door contacts, and request-to-exit devices. Cabling, control panels, and power supplies will be provided to support devices.

2. System will be tested to ensure failures are remediated, and that the system will be turnkey.
 3. Credentials will be provided for proper access through the project boundaries. In addition, access levels/groups, user information, and visitor information will be coordinated.
 4. Duress button will be provided to notify Security of an incident or emergency.
 5. Motion detectors and door contacts will be provided to alarm buildings.
- B. Intercom System
1. A communication system will be provided for remote communication and access from designated entryways and portals via intercoms and dry contact relays.
 2. Communication devices will be provided on stanchion/tower style columns for emergency and assistance calls. Locations and installation will conform with ADA requirements.
 3. Cabling will be provided to support devices. Power will be provided in locations requiring fiber media conversion.

PART 2 — PRODUCTS

2.01 ACCESS CONTROL SYSTEM APPLICATION

- A. System shall be capable of the following:
1. Customizable GUI with the ability for customizable icons to be placed onto a floor plan.
 2. Real-time monitoring of doors, users, controllers, and devices.
 - i. Over 2000 card readers
 - ii. Over 5000 inputs
 - iii. Over 5000 outputs
 - iv. Up to 500,000 users
 3. User permission modifications.
 4. Scheduled door unlock.
 5. Scheduled door monitoring.
 6. Geofencing and location restrictions.
 7. Export of events in CSV and PDF formats for auditing.
 8. Remote door lockdown.

9. Setting alerts for user behavior.
 10. Supports active directory.
 11. Future mobile credentials.
 12. Native integrations and additional integrations via SDK/API.
 13. RAID5 or RAID6 configuration.
- B. Provide servers capable of hosting system applications.
1. Refer to manufacturer's recommendations and guidelines for performance requirements.
- C. Provide licenses to support complete installation.
- D. Manufacturer
1. Genetec Synergis

2.02 ACCESS CONTROL PANELS AND ENCLOSURES

- A. Panel boards shall be capable of the following:
1. OSDP communications between panel and credential readers.
 2. RS-485 communications.
 3. Local storage of over 10,000 credentials.
 4. Network offline functionality.
- B. Panels shall be:
1. Powered by local power supply in the same or adjacent enclosure.
 2. Able to support up to (16) credential readers and doors per panel.
 3. Sized or have the ability to support input and output boards.
- C. Control panel shall match Owner's standard manufacturer.
1. Control panels shall consist of:
 - i. Intelligent controllers
 - ii. Credential reader boards
 - iii. Input boards
 - iv. Output boards
- D. Provide 2, 4, or 8-door control panels.

- E. Manufacturer
 - 1. Genetec Synergis
 - 2. Mercury LP1502
 - 3. Mercury LP1501
 - 4. Mercury MR16IN
 - 5. Mercury MR16OUT
- F. Enclosures shall house panel boards shall be provided. Provide (1) of the following:
 - 1. Same as system manufacturer
 - 2. Lifesafety Power
 - 3. Altronix
 - 4. nVent Hoffman

2.03 POWER SUPPLIES AND ENCLOSURES

- A. Supply boards shall:
 - 1. Be able to accept 120VDC at 60 Hz.
 - 2. Have input protection.
 - 3. Have independent battery back-up for up to (24) hours of runtime.
 - 4. Have fault supervision.
 - 5. Be able to support up to (16) fused or resettable outputs per panel.
 - 6. Accept fire alarm inputs.
- B. Power supplies shall match Owner's standard manufacturer.
- C. Where standards do not specify a manufacturer, provide (1) of the following:
 - 1. Separate power supply enclosure from access control enclosure:
 - i. Lifesafety Power
 - ii. Altronix
 - 2. Integrated power supply and access control enclosure
 - i. Lifesafety Power Unified
 - 3. Batteries shall be sized for (24) hours of continuous runtime.
 - i. Yuasa

- ii. Or equal

2.04 CREDENTIAL READERS

- A. Credential readers shall:
 - 1. Operate at both 125 kHz and 13.56 MHz.
 - 2. Operate at the same frequency as credentials.
 - 3. Communicate via OSDP with the access control panel.
 - 4. Have keypad
- B. Manufacturer:
 - 1. HID Signo 20K

2.05 REQUEST-TO-EXIT (REX) DEVICES

- A. REX devices shall be integrated with the door hardware. Refer to Division 8.
- B. For doors without integrated REX, REX devices shall:
 - 1. Operate at 12 or 24V DC.
 - 2. Mount to a single gang mud ring.
 - 3. Have adjustable coverable patterns.
 - 4. Selectable relay triggers.
- C. Non-integrated REX shall match Owner's standard manufacturer.
- D. Manufacturer:
 - 1. Bosch DS160

2.06 ELECTRIFIED LOCKSETS

- A. Electrified locksets shall be integrated with the door hardware. Refer to Division 8.

2.07 THROUGH-WIRE ELECTRIFIED TRANSFER HINGES

- A. Through-wire electrified transfer hinges shall be provided with the door hardware. Refer to Division 8.

2.08 DOOR CONTACTS

- A. Door contacts shall be provided with the door hardware. Refer to Division 8.
- B. Where Division 8 does not specify door contacts, contacts devices shall:
 - 1. Be form C dry contact.

2. Be DPDT.
 3. Match door frame color or be paintable.
- C. Door contacts shall match Owner's standard manufacturer.
1. Manufacturer shall be able to provide the following types of door contacts:
 - i. Recessed Reed Switch
 - ii. Surface
 - iii. Multiple form factors and environmental conditions.
- D. Manufacturer:
1. George Risk Industries
 2. Or equal

2.09 END-OF-LINE RESISTORS

- A. End-of-line resistors shall be capable of multiple configurations.
- B. Provide (1) of the following:
1. George Risk Industries
 2. TE Connectivity
 3. Or equal

2.10 CABLING

- A. Cabling shall be listed and rated for the environment.
- B. Provide surge protection where cabling enters building with a dedicated path to building ground.
- C. Conductor sizes shall fit into device terminals. Minimum conductor size shall be 18 AWG.
- D. Provide the following cable types:
1. Credential readers
 - i. 24 AWG, 4 conductors, twisted-pair, shielded, RS-485, 120-ohm
 2. Door contacts
 - i. 4 conductors, shielded
 3. Electrified locksets
 - i. 4 conductors, shielded

- 4. Request-to-exit devices or exit buttons
 - i. 4 conductors, shielded
 - 5. Miscellaneous devices
 - i. 4 conductors, shielded
- E. Door cabling shall:
 - 1. Be provided with 120-ohm termination resistors where card readers are OSDP.
 - 2. Have multiple components for every door device in an overall composite.
 - i. Credential reader component cable shall be compliant with RS-485/OSDP standards.
 - ii. Lock and credential reader gauge shall be sized for maximum 10% voltage drop from panel to device.
 - 3. Be coordinated with device and hardware conductor gauges.
- F. RS-485 cabling
 - 1. Shall be compliant with RS-485 standards.
- G. Manufacturers:
 - 1. Smartwire
 - 2. Paige Datacom
 - 3. Belden
 - 4. Or equal
- H. Refer to Division 27 for network cabling.
 - 1. Provide fiber media converters where required.

PART 3 — EXECUTION

3.01 GENERAL

- A. The Contractor shall input the credential data into the access control software.
- B. Provide any required screws, anchors, clamps, hook and loop, miscellaneous grounding and support hardware, etc. needed to facilitate the installation of the cable plant system.
- C. Furnish any special installation equipment or tools necessary to properly complete the installation.
- D. Do not roll or store cable reels without an appropriate support structure.

- E. Failure to follow the appropriate guidelines may require the installer to provide additional material and labor required to properly rectify the situation. This shall also apply to any and all damages caused to the cables by the installer during the implementation.
- F. Provide fire blocking at all fire-rated penetrations.
- G. Plug conduits where cabling has been installed in the main equipment room, backbone, and other cable entrance locations with re-enterable duct seal of flame retardant putty.
- H. All techniques and fixtures used in the installation must minimize complexity and must allow for easy maintenance of, and ready access to, all components for test measurements.
- I. All materials used in installation shall be resistant to fungus growth and moisture deterioration.
- J. All of the pathways shown on the drawings are suggested routes for the Contractor to use as guidelines. Prior to construction, the Contractor shall coordinate in the field with other trades to determine the exact feeder, tie, and riser backbone cabling pathways. In any case where the communication pathway must be removed and re-routed, due to conflicts with other trades with which the Contractor did not previously coordinate, the Contractor is responsible for all costs associated with the removal and relocation.

3.02 ACCESS CONTROL SYSTEM APPLICATION

- A. Ensure application is viewable from Owner-selected workstation.
- B. Coordinate access levels and group configurations with Owner.
- C. Coordinate integration of active directory and new users with Owner.
- D. Coordinate door scheduling with Owner.
- E. Coordinate integration with Video Surveillance System and visitor management system.
- F. Coordinate system application, programming, notifications, and GUI configuration with Owner.
- G. Coordinate change of default passwords with Owner.
- H. Ensure the following door statuses are functioning:
 - 1. Access granted
 - 2. Access denied
 - 3. Door forced open
 - 4. Door held open

3.03 ACCESS CONTROL PANELS AND ENCLOSURES

- A. Enclosures shall be mounted to plywood.

- B. Patch cords will be provided for connecting to the network.
- C. Coordinate and document board MAC and IP addresses with Owner.
- D. Wire enclosure tamper switches.

3.04 POWER SUPPLIES AND ENCLOSURES

- A. Enclosures shall be mounted to plywood.
- B. Circuits shall be dedicated and not shared with other systems.
- C. Input power shall be hardwired.
- D. Provide input surge protection.
- E. Provide lock diodes where not integral to the lock. Coordinate with Division 8.

3.05 CREDENTIAL READERS

- A. Mount square to device backbox.
- B. Provide spacers where read range is impacted by nearby readers or backplanes.
- C. Terminations shall be pigtailed.
- D. Coordinate LED and sounder programming with Owner.
- E. Ensure rough-in is ADA-compliant, and that junction boxes/pathways are on the secured side of the door.
- F. Remove non-factory paint after walls are finished.

3.06 REQUEST-TO-EXIT DEVICES

- A. For integrated REX devices, coordinate terminations and wire handoff with Division 8.
 - 1. Ensure REX is functioning prior to installation.
- B. For non-integrated REX devices:
 - 1. Mount square to device backbox.
 - 2. Aim detection pattern as close as possible to door handle.
 - 3. Detection pattern shall not reflect off of adjacent surfaces or pass through openings to allow accidental device activation.

3.07 ELECTRIFIED LOCKSETS

- A. Coordinate terminations and wire handoff with Division 8.
 - 1. Ensure electrified lockset is functioning prior to installation.

- B. Coordinate wiring for doors with automatic push plates and door operators. Under no circumstance shall a push plate activate the door operator without an authorized credential read.
- C. For doors with power supplies above the door, coordinate system configuration with Divisions 26 and 8.
- D. Doors shall be failsecure with mechanical egress.
- E. Provide fire relays at headend locations and at doors with power supplies above the door. Coordinate fire alarm integration with Fire Alarm Contractor.

3.08 THROUGH-WIRE ELECTRIFIED TRANSFER HINGES

- A. Coordinate terminations and wire handoff with Division 8.
 - 1. Ensure through-wire electrified transfer hinge is functioning prior to installation.
- B. Measure voltage drop at the lock termination from the power source.

3.09 DOOR CONTACTS

- A. Shall be recessed for door frames. Provide surface-mounted contacts where recessing is not possible.
- B. Coordinate door frame drilling and mounting with Division 8.
- C. Contacts shall be secured and flush to mounting surface.
- D. Contact color shall be closely matched with door frame.
- E. In locations where armored loops are required, locate rough-in as close as possible to door for minimal loop length.
- F. No more than (1) contact will be allowed per door leaf. For doors with multiple leaves, normally-open or normally-closed configuration shall be consistent throughout project.

3.10 END-OF-LINE RESISTORS

- A. Provide configurations compliant with access control panel manufacturer.
- B. Provide on device side. Resistors at the headend will be rejected.

3.11 CABLING

- A. All cable runs must be continuous from the panel to the device location.
- B. Group and bundle all cabling. Do not bundle with other systems.
 - 1. Division 27 cabling provided for Division 28 cabling are allowed to be bundled together.
- C. Device wiring shall be consistent and documented. Color codes shall be uniform.

- D. All cables shall originate and terminate at active or passive devices. Cables shall not be spliced. Where several devices are in close proximity, use approved housing to housing connectors and adapters.
- E. Strip and terminate cabling utilizing manufacturer's recommended tools. Pins, plugs, and terminals shall not be damaged.
- F. All cables terminated in a connection plate mounted in an enclosure shall be dressed to allow cables to be removed from the enclosure and shall be of sufficient cable length to allow for service or re-termination. The plate shall either set on the floor or freely swing clear.
- G. Cabling shall not be visible when walking through the facility. Cabling shall be in conduits, in cable tray, or in j-hooks above accessible ceiling.
- H. All cables installed in vertical tray or chases shall be supported by means of appropriately-sized vertical cable supports on every third floor. Do not use nylon cable ties.
- I. Cables shall not be pulled across sharp edges. Provide protection where edges exist or manually grind down edges for a smooth, polished surface.
- J. Cables shall not be jammed between assemblies or equipment.
- K. Abide by manufacturer's pulling tension and bend radii.
- L. Cable Installation in Conduit
 - 1. Through the entire length of all underground conduits, pull mandrel that is one size smaller than the conduit.
 - 2. When pulling cable, use water-based pulling lubrication. Lubricants that harden after installation are not allowed.
 - 3. During long or difficult runs, use a dynamometer to measure pulling tension. Place the dynamometer between the cable puller and the pull line to monitor pulling tension. Do not exceed the manufacturer's maximum pulling tension.
 - 4. Apply pulling grips suitable for use with copper cables to the ends of the cable. Consult the cable manufacturer to determine the appropriate pulling grip and method of attachment. Use breakaway or fuse links at the pulling grip and ensure that the correct "fuse pin" is installed in the fuse link. Channel locks and pliers used for pulling are now allowed.
 - 5. To protect the cable ends until they are terminated, use cable caps (heat-shrinking type) to seal the ends of the cable.
 - 6. Use cable blocks to facilitate the bending of cable. For bends between 5° and 45°, use a 45° cable block. For bends between 45° and 90°, use a 90° cable block.
 - 7. The bend radius for all cables shall conform to manufacturer's specifications.

- M. Provide 6' service loop in overhead runway in Technology rooms or at headend location.
- N. Provide 6' service loop in device backbox, nearest cable tray, or j-hook, wherever is closest to the cable termination.
- O. Do not expose cable to water, paint overspray, paint removal products, or water-based pulling lubricants, as these substances can negatively impact the performance of the cable.
- P. Use cable bundling and securing materials as required to ensure that cable runs are securely held in place both vertically and horizontally.
- Q. Do not tighten bundling materials or securing devices so as to cause deformation of the inherent cable geometry or construction.
- R. Cables shall be dressed, bundled, and neatly arranged.
- S. Do not use cable ties or hook and latch tape to secure cable runs to other building systems (such as electrical conduit, EMT, sprinkler pipes, ceiling suspension members, etc.). Staples and drive rings are not allowed.
- T. In areas considered environment air-handling spaces, only use appropriately-listed materials.

3.12 LABELING

- A. Batteries shall be labeled with installation date.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Removal of vegetation, grass, grass roots, shrubs, tree stumps, trees, upturned stumps, weed growth, tree roots, brush, masonry, concrete, rubbish, debris and other materials.
2. Removal of concrete and bituminous surfaces.
3. Removal of existing fences and gates.

B. Related Requirements:

1. Section 31 2200 - Grading.
2. Section 31 2316 - Excavation and Fill for Pavement.
3. Section 31 2323 - Excavation and Fill for Utilities.
4. Section 31 2326 - Base Course.

1.02 SUBMITTALS

- A. Shop Drawings: Submit site plan indicating extent of site clearing.

1.03 QUALITY ASSURANCE

- A. Comply with Standard Specifications for Public Works Construction, current edition, as a minimum requirement.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 TREE AND STUMP REMOVAL

- A. Remove trees and stumps indicated or required to be removed. Remove trees, together with bulk of roots, to a minimum depth of 4 feet below required grade, and within a radius of approximately 7 feet beyond perimeter of trunk at grade.
- B. Fill and compact excavation from tree and stump removal. Fill in 6 inch layers, each compacted to 90 percent of maximum density in accordance with ASTM D1557.
1. Back filling shall not commence until the excavation is inspected and tested.

3.02 CONCRETE AND BITUMINOUS SURFACING REMOVAL

- A. Break up and completely remove existing concrete surfacing, curbs, gutters, walks and bituminous surfacing to indicate limits. Cutting shall be performed to a neat and even line with proper tools or a concrete cutting saw. Minimum depth of cut shall be 1 1/2-inch, unless otherwise indicated. Remove concrete broken beyond the indicated limits to the nearest joint or score line and replace with new concrete to match existing.

3.03 FENCING

- A. Existing fences scheduled to remain may be removed to facilitate the Work, provided they are installed to their original condition in accordance with requirements of Section 32 3113 - Chain Link Fences and Gates.
- B. Fencing indicated to be removed and not reinstalled shall be completely removed, including footings. Fill and compact excavations.
- C. Install chain link fencing indicated to be relocated or reset in accordance with applicable requirements specified under Section 32 3113 - Chain Link Fences and Gates.

3.04 CLEANUP

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

END OF SECTION

SECTION 31 22 00

GRADING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. General exterior grading, cutting and filling, including grading for building area, paving, planting areas, banks and hillsides.

B. Related Requirements:

1. Section 31 1000 - Site Clearing.
2. Section 31 2316 - Excavation and Fill for Pavement.
3. Section 31 2323 - Excavation and Fill for Utilities.
4. Section 31 2326 - Base Course.

1.02 PROJECT REQUIREMENTS

A. General:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.
4. Before grading, contact Underground Service Alert of Southern California (USASC) for information on public buried utilities and pipelines. Retain the services of an underground utility locator for on-site utilities.

PART 2 - PRODUCTS

2.01 MATERIALS

- ###### **A. Materials shall conform to requirements specified in this and related sections.**

PART 3 - EXECUTION

3.01 PREPARATION

- ###### **A. Protect and maintain installed stakes until their removal is required for the Work. Provide replacement grade or location stakes lost or disturbed.**
- ###### **B. Install grade stakes and compare to indicated grades. If discrepancies are found between existing grades and grades indicated on Drawings, do not proceed until discrepancies are resolved.**

3.02 ROUGH AND FINE GRADING

A. Rough grade area sufficiently high to require cutting by fine grading:

1. Grade area for bituminous surfacing and other paving to the indicated grades, equal to the section of the indicated base and pavement.
2. Slope banks to required finish grades as cut progresses or leave cuts full and

finish grade by mechanical equipment to provide grades and soil densities indicated on the Drawings.

3. Rough grade, fill and compact banks beyond indicated finish grades. Finish grade banks and slopes to indicated grades and specified soil densities.
4. Grade Only Areas: In areas not indicated to receive pavement, rough grade to approximate finish grades and then scarify, moisten and roll to obtain required density and indicated finish grades.
5. Tolerances: Finish grades shall be within a tolerance of 0.05 inch per foot above or below grades indicated. Provide an average grade as indicated.

B. Base or Subgrade:

1. After subgrade has been constructed to approximate required grades, scarify to a depth of at least 6 inches:
 - a. After scarifying, process loosened material to a finely divided condition and adjust moisture content to optimum condition by addition of water, addition and blending of dry suitable material, or by drying of existing material.
 - b. Subgrade material shall be compacted by tamping, sheepsfoot rollers or pneumatic tire rollers. Required relative compaction shall be 90 percent minimum for the top 6 inches below subgrade.
 - c. Install base course in accordance with Section 31 2326 - Base Course.
2. Tolerance of completed grades of base or subgrade shall not vary more than 0.03 inch per foot from grades indicated. Provide an average grade as indicated.

3.03 SHORING

- A. Provide shoring as necessary to properly and safely support earth sides of excavations, and existing curbs, sidewalks, gutter, drives and stairs, against movement and collapse.
- B. Design and Calculations: Provide in accordance with requirement of CalOHSA.
- C. Remove shoring upon completion of the Work of this section or when no longer needed unless required otherwise by authorities having jurisdiction.

3.04 EXCESS MATERIAL DISPOSAL

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

3.05 PROTECTION

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

END OF SECTION

SECTION 31 23 16

EXCAVATION AND FILL FOR PAVING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Excavating, backfill, and compacting for paved areas.
2. Installation of fill materials.

B. Related Requirements:

1. Section 31 1000 - Site Clearing.
2. Section 31 2200 - Grading.
3. Section 31 2323 - Excavation and Fill for Utilities.
4. Section 32 2326 - Base Course.
5. Section 32 0117 - Pavement Repair.
6. Section 32 1216 - Asphalt Paving.
7. Section 32 1313 - Site Concrete Work.

1.02 PROJECT REQUIREMENTS

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.03 QUALITY ASSURANCE

- A. Comply with Standard Specifications for Public Works Construction, current edition, except as modified herein.

1.04 TESTING

- A. OWNER will retain a Geotechnical Engineer as an OWNER Consultant who will provide observations, tests, inspections and approvals identified in the Contract Documents as being responsibility of OWNER.
- B. Imported Soils: The Geotechnical Engineer will obtain initial product Sample for testing in accordance Article 3.05 of this Section.

1.05 PROJECT CONDITIONS

- A. Information on Drawings or in soils report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.

PART 2 - PRODUCTS

2.01 BASE MATERIALS

- A. Concrete Slabs On Grade: Provide "Crushed Aggregate Base "as specified in the Standard Specifications for Public Works Construction, Section 200: "Rock Materials,"

with ¾ inch maximum size aggregates. Provide 3-inch thick base, unless noted otherwise.

- B. Bituminous Surfacing: As indicated on Drawings and specified in Section 31 2326 - Base Course.

2.02 FILL AND BACKFILL MATERIALS

- A. Fill and backfill materials shall be previously excavated materials or imported fill material, free of clods and stones larger than 3-inch, foreign materials, vegetable growths, sod, expansive soils, rubbish and debris. Material shall conform to these specified requirements and related sections.

- B. Fill material exhibiting a wide variation in consistency and moisture content shall be blended or aerated to stabilize and upgrade the material.

C. Imported Fill Material:

1. Provide suitable materials obtained from Project site excavations for earthwork and fill materials. If excavated materials are not of suitable quality or sufficient quantity, import additional materials as necessary.
2. Imported fill shall be a granular material with sufficient binder to form a firm and stable unyielding subgrade and shall not have more than 60 percent of fines passing 200 mesh sieve. Material shall have a coefficient of expansion of not more than 2 percent from air dry to optimum moisture content and not more than 6 percent from air dry to saturation. Imported material shall be clean and free of rubbish, debris, and toxic or hazardous contaminants. Adobe or clay soils are not permitted.

- D. Brick rubble and broken concrete originating from the Project site shall be legally disposed of off the Project site. No such materials shall be imported from outside the Project site.

E. Permeable Backfill:

1. Provide permeable backfill material behind retaining structures consisting of gravel, crushed gravel, crushed rock, natural sands, manufactured sand, or combinations of these materials conforming to the following gradations:

Sieve Size:	Percentage Passing:
¾ inch (19mm)	100
⅜ inch (10mm)	80 to 100
No. 100	0 to 8
No. 200	0 to 3

2. Those portions of fill material passing a No. 4 sieve shall provide a sand equivalent of at least 60.
3. Provided backing for weep holes shall consist of two cubic feet of aggregate in burlap sacks, securely tied. Aggregate shall conform to requirements for No. 3 concrete aggregate as specified in subsection 200-1.4 of the Standard Specifications for Public Works Construction.
4. Permeable Backfill Alternate Materials: Instead of the materials specified for retaining structures backfill, a drainage matting system, Miradrain by Mirafi, Inc., or equal, may be provided if reviewed and approved by the ARCHITECT.

PART 3 - EXECUTION

3.01 GENERAL

- A. Before initiating intrusive activities, contact Underground Service Alert of Southern California (USA or Dig Alert) to obtain a Dig Alert ticket for location information on buried public and USA member utilities and pipelines at least 48-hours prior to beginning work. A copy of the Dig Alert ticket shall be forwarded to the OWNER. For on-site utilities, retain a state-licensed third party underground utility locating service.
- B. Clear the Project site as indicated in Section 31 1000 - Site Clearing.

3.02 PROTECTION

- A. Protect and guard excavations against danger to life, limb, and property as required by, but not limited to, Cal-OSHA regulations.
- B. Protect adjacent existing improvements including landscaping against damage.

3.03 EXISTING UTILITY LINES

- A. Protect existing utility lines from damage or displacement.
- B. Remove conduits or pipes not in service, exposed during Work, unless a minimum cover of 2 feet is provided. Remove concrete, clay or other non-metallic pipe over 8 inches in diameter, unless otherwise indicated.

3.04 EXCAVATION

- A. Unclassified Excavations: Comply with the Standard Specifications for Public Works Construction, Section 300: "Earthwork," except as modified herein.

3.05 FILL

- A. Unclassified Fill and Compaction: Comply with the Standard Specifications for Public Works Construction, Section 300: "Earthwork," except as modified herein.
- B. Provide fill materials as specified in Part 2 - Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.
- C. Imported fill materials will be sampled by the Geotechnical Engineer for compliance with the requirements of Part 2 of this Section.
- D. The Geotechnical Engineer will submit samples to a DSA approved independent approved testing laboratory for testing.
- E. Initial sampling will be performed by the Geotechnical Engineer before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and/or entity responsible for the source site. The Geotechnical Engineer will obtain both the initial and additional samples from the identified site and will submit samples to the approved independent testing laboratory for testing.
- F. The Geotechnical Engineer will perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1,000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1,000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.
- G. The independent approved testing laboratory will perform the required tests and report results of tests noting if the tested material passed or failed such tests and will furnish copies to the Project Inspector, ARCHITECT, OAR, DSA, CONTRACTOR, and others as

required. Report shall state tests were conducted under the responsible charge of a California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, CBC, and the DSA. Upon completion of the Work of this Section, the independent testing laboratory and Geotechnical Engineer shall submit a verified report to the DSA as required by CBC.

- H. Bills of lading or equivalent documentation will be submitted to the Project Inspector on a daily basis.
- I. Upon completion of import operations, provide the OAR a certification statement attesting that imported material has been obtained from the identified source site.

3.06 INSTALLATION OF MATERIALS

- A. Fill or backfill materials shall be installed in horizontal layers of 6 inches, unless otherwise required. Each layer shall be evenly placed and moistened or aerated as necessary. Unless otherwise reviewed by the Geotechnical Engineer, each layer of fill material shall cover the length and width of the area to be filled before the next layer of material is installed. Top surface of each layer shall be installed to an approximate level with a crown or crossfall of at least 1 in 50, but no more than 1 in 20. Provide adequate drainage at all times during construction of the Work of this Section.

3.07 COMPACTING

- A. Each layer of fill material shall be compacted by tamping, sheepsfoot rollers, or pneumatic-tired rollers to provide specified relative compaction. At inaccessible locations, provide specified compaction by manually held, operated and directed compaction equipment.
- B. Unless otherwise indicated, compact each layer of earth fill to a relative compaction of at least 90 percent.
- C. When fill materials, or a combination of fill materials, are encountered or provided which develop densely packed surfaces as a result of installation or compacting operations, scarify each compacted layer before installing the next succeeding layer.

3.08 INSPECTION AND TESTING

- A. The Geotechnical Engineer will inspect and test excavations, sample material quality as required in Part 2, and observe installation and compaction of fill materials.
- B. The Geotechnical Engineer will sample imported fill materials from their designated source before delivery to the Project site.
- C. Installation of backfill will be observed by the Geotechnical Engineer.
- D. The Geotechnical Engineer will inspect and test excavation Work before the installation of fill and/or other materials.
- E. Compaction: Test compaction in accordance with ASTM D1557, Method C.

3.09 PROTECTION

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

3.10 CLEANING

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

END OF SECTION

SECTION 31 23 23

EXCAVATION AND FILL FOR UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Excavating, backfilling, and compacting utility trenches such as water, gas, irrigation, storm drain, sewer lines, concrete-encased conduits, and manholes, vaults, valve boxes, catch basins, underground tanks, thrust blocks, yard boxes, pull boxes and other utility appurtenances.

B. Related Requirements:

1. Section 31 1000 - Site Clearing.
2. Section 31 2200 - Grading.
3. Section 31 2316 - Excavation and Fill for Paving.
4. Section 32 0117 - Pavement Repair.
5. Section 32 1313 - Site Concrete Work.
7. Section 33 4000 - Storm Drainage Utilities.

1.02 PROJECT REQUIREMENTS

A. Import and Export of Earth Materials:

1. Fees: Pay as required by authorities having jurisdiction over the area.
2. Bonds: Post as required by authorities having jurisdiction over the area.
3. Haul Routes and Restrictions: Comply with requirements of authorities having jurisdiction over the area.

1.03 QUALITY ASSURANCE

- ###### A.
- Comply with the following as a minimum requirement: Standard Specifications for Public Works construction, current edition except as modified herein.

1.04 TESTING

- ###### A.
- OWNER will retain a Geotechnical Engineer as an OWNER Consultant who will provide observations, tests, inspections and approvals identified in the Contract Documents as being responsibility of OWNER.
- ###### B.
- Imported Soils: The Geotechnical Engineer will obtain initial product Sample for testing in accordance Article 3.02 of this Section.

1.05 PROJECT CONDITIONS

- ###### A.
- Information on Drawings or in soils report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Bedding material from trench bottom to one foot above the pipe:

1. Sand, gravel, crushed aggregate or native free-draining granular material providing a sand equivalent of at least 30 or a coefficient of permeability greater than 1.4 inches per hour.

2. Sand complying with the Specifications for cement concrete aggregates.

B. Backfill Materials:

1. Excavated trench material to be installed for backfilling shall be clean, free of large clods, and stones larger than 2 ½-inch in any dimension.
2. Cement-sand slurry shall be provided with one sack of cement per cubic yard of the mixture.
3. Imported Fill Material: Imported fill material shall be a granular material with sufficient binder to form a firm and stable unyielding subgrade and shall not have more than 60 percent of fines passing a 200 mesh sieve. Material shall provide a coefficient of expansion of not more than two percent from air dry to optimum moisture content and not more than six percent from air dry to saturation. Imported materials shall be clean and free of rubbish, debris, and toxic or hazardous contaminants. Adobe or clay soils are not permitted.

PART 3 - EXECUTION

3.01 GENERAL

- A. Before initiating intrusive activities, contact Underground Service Alert of Southern California (USA or Dig Alert) to obtain a Dig Alert ticket for location information on buried public and USA member utilities and pipelines at least 48-hours prior to beginning work. A copy of the Dig Alert ticket shall be forwarded to the OWNER. For on-site utilities, retain a state-licensed third party underground utility locating service.
- B. Barricade trenches, ditches, pits, sumps, and similar Work outside the barricaded working area with chain link fence, Construction Facilities and Temporary Controls, and in accordance with Cal-OSHA standards and requirements.
- C. Saw-cut concrete or bituminous paving for trench installation.
- D. Trenches over 5 feet in depth shall conform to the Cal-OSHA.
- E. Where indicated and required to excavate in lawn areas, protect adjoining lawn areas outside of the Work area. Replace or install removed sod upon completion of backfill by installing sod level with adjacent lawns. If installation of removed sod fails, furnish sod and install to match existing lawns.
- F. Backfill over excavations to the required elevations with earth, gravel, sand, or concrete and compact as required. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. Slope adjacent grades away from excavations to minimize entry of water.
- G. Do not install piping lengthwise under concrete walks without review by the ARCHITECT.
- H. Do not excavate trenches parallel to footings closer than 18 inches from the face of the footing or below a plane having a downward slope of two horizontal to one vertical, from a line 9 inches above bottom of footings.
 1. Unless otherwise indicated on Drawings, depth of excavations outside the buildings shall allow for a minimum coverage above top of pipe, tank, or conduit measured from the lowest adjoining finished grade, as follows:

Steel Pipe	24 inches below finished grade
Copper Water Tube	18 inches below finished grade

Cast-Iron Pressure Pipe	36 inches below finished grade
Plastic Pipe (other than waste)	30 inches below finished grade

Soil, Sewer & Storm Drain	Minimum 18 inches below finished grade, and as required for proper pitch and traffic load. (Install polypropylene sewer pipe with at least 24 inches coverage)

Irrigation Pipe: inches	nonpressure pipe 12 inches, pressure pipe 24 inches

2. Trench width shall provide ample space for fitting and joining. Excavate for piping bells and fittings, bell and spigot pipe and other fittings.

- I. Unless indicated otherwise, excavate trenches to the required depths for utilities, such as pipes, conduit and tanks, with minimum allowances of 6 inches at the bottom and 6 inches at the sides for bedding of unprotected piping or as required for concrete encasement of conduits as indicated on Drawings. Grade bottom of trenches to a uniform smooth surface. Remove loose soil from the excavation before installing sand bedding or concrete encasement.
- J. Provide excavations free from standing water by pumping, draining, or providing protection against water intrusion. If soil becomes soft, soggy, or saturated, excavate to firm undisturbed soil and fill as required. Slope adjacent grades away from excavations to minimize entry of water.
- K. Provide a minimum clear dimension of 2 inches from sides of wall excavation to outer surfaces of buried pipes or conduits installed in the same trench or outside surfaces of containers and tanks.
- L. Do not install backfill until required inspections and testing is completed.
- M. Backfill electrical or other excavated utility trenches located outside of barricaded installation areas within 24 hours after inspection by the Project Inspector.
- N. Install backfill materials in layers not exceeding 4 inches in thickness and compact to 90 percent of the maximum density.
- O. If materials excavated from the Project site are not permitted for trench backfill in paved areas, backfill trenches with a cement-sand slurry mix. Install backfill to an elevation of the existing undisturbed grade plus one inch.
- P. Install and compact sand bedding to provide a uniform full length bearing under piping and conduits.
- Q. Where portions of existing structures, walks, paving, or other improvements are removed or cut for piping or conduit installation, replace the material with equal quality, finished to match adjoining existing improvements. Repair pavement as specified in Section 32 0117, Pavement Repair.

3.02 IMPORT/EXPORT OF MATERIALS

- A. Provide fill materials as specified in Part 2, Products. If excavated materials from the Project site are not of required quality or sufficient quantity, import additional materials as necessary.
- B. Imported fill materials will be sampled by the Geotechnical Engineer for compliance with the requirements of Part 2 of this Section.
- C. The Geotechnical Engineer will perform the tests by utilizing an independent approved testing laboratory.

- D. Initial sampling will be performed by the Geotechnical Engineer before importing material to the Project site. Identify the location of the source site in addition to the address, name of the person and/or entity responsible for the source site. The Geotechnical Engineer will obtain both the initial sample and additional samples from the identified site and shall submit all samples to the approved independent testing laboratory.
 - E. The Geotechnical Engineer will perform additional sampling during import operations. If the total quantity of import is determined to be greater than 1,000 cubic yards of material, one sample shall be obtained and submitted for testing for each 250 cubic yards of imported material. If the total quantity of import is determined to be less than 1,000 yards, one sample shall be obtained and submitted for testing for each 100 cubic yards of imported material.
 - F. The independent approved testing laboratory will perform the required tests and report results of all tests noting if the tested material passed or failed such tests and will furnish copies to the Project Inspector, ARCHITECT, OAR, DSA, CONTRACTOR, and others as required. Report shall state tests were conducted under the responsible charge of a licensed State of California professional engineer and the material was tested in accordance with applicable provisions of the Contract Documents, CBC and the DSA. Upon completion of the Work of this Section, the independent testing laboratory and Geotechnical Engineer will submit a verified report to the DSA as required by CBC.
 - G. Bills of lading or equivalent documentation will be submitted to the Project Inspector on a daily basis.
 - H. Upon completion of import operations, provide the OAR a certification statement attesting that imported material has been obtained from the identified source site.
- 3.03 INSPECTION AND TESTING
- A. The Geotechnical Engineer will inspect and test excavations, sample material quality as required in Part 2, observe installation and compaction of fill materials.
 - B. Compaction test shall be performed in accordance with ASTM D1557, method "C."
- 3.04 PROTECTION
- A. Protect the Work of this Section until Substantial Completion.
- 3.05 CLEANUP
- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 31 23 26

BASE COURSE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Installation of base material.

B. Related Requirements:

1. Division 01 - General Requirements.
3. Section 31 1000 - Site Clearing.
4. Section 31 2200 - Grading.
5. Section 31 2313 - Excavation and Fill.
6. Section 31 2316 - Excavation and Fill for Paving.
6. Section 32 0117 - Pavement Repair.
7. Section 32 1216 - Asphalt Paving.
9. Section 32 1313 - Site Concrete Work.

1.02 SUBMITTALS

- A. Crushed aggregate base (CAB) shall consist of native rock without naturally occurring asbestos or recycled materials. The CONTRACTOR shall submit written documentation, which identifies the source, volume, and proposed transport date of the material for review and approval by OWNER'S Office of Environmental Health and Safety (OEHS) prior to importing the material. A statement on company letterhead from the CAB source, stamped by either a California Professional Geologist or Engineer, which states that the subject materials are native rock, do not contain any recycled materials and that the source quarry does not mine ultramafic materials, a source of natural occurring asbestos shall be included in the submittal to OEHS. The CONTRACTOR may request variance from analytical testing required by Section 01 4524 for CAB. To be considered for a variance, the CONTRACTOR shall submit a documentation package for OEHS approval, which includes all of the aforementioned information at least 48 hours in advance of planned import.

1. Frequently used suppliers include:

- a. Hansen Aggregates.
- b. Vulcan Materials, Reliance Company.
- c. Vulcan Materials Durbin.

- C. Product Data: Submit material source, technical information and test data for base materials. Gradation and quality certifications shall be dated within 30 days of the submittal.

- D. Sample: Submit sample of proposed base course material.

1.03 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement: Standard Specifications for Public Works Construction, current edition.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Crushed Aggregate Base (CAB) materials shall conform to the requirements of the Standard Specifications for Public Works Construction: Section 200 - Rock Materials.
- B. Crushed Miscellaneous Base (CMB) or materials generated on site shall not be used as a base course material.

2.02 MATERIAL APPROVAL

- A. Base material shall be inspected by the Project Inspector for gradation and material content prior to installation. The OWNER may choose to have additional tests performed by a geotechnical engineer, retained by the OWNER, before installation.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install base course material in layers not exceeding 4 inches in thickness, unless required otherwise. Grade and compact to indicated levels or grades, cut and fill, water and roll until the surface is hard and true to line, grade and required section. Provide a relative compaction of at least 95 percent, unless otherwise required.
- B. Grade base course to elevations indicated on Drawings, ready to receive surfacing, in accordance with Section 31 2200 - Grading.

3.02 PROTECTION

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

3.03 CLEANUP

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

END OF SECTION

SECTION 32 01 17

ASPHALT PAVEMENT REPAIR

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Bituminous Surfacing Repair: Areas removed for utility trenches, heaved by tree roots, cracked areas, protruding areas where pavement meets hard surfaces, depressed areas, holes and areas around new structures, and raveled bituminous pavement.
2. Areas heaved by tree roots, cracked areas, holes and trenches, and areas around new structures.

B. Related Sections:

1. Division 01 - General Requirements.
2. Section 31 2200 - Grading.
3. Section 31 2316 - Excavation and Fill for Paving.
4. Section 31 2323 - Excavation and Fill for Utilities.
5. Section 31 2326 - Base Course.
6. Section 32 0113 - Rolled Slurry Seal, Existing Pavement.
7. Section 32 1216 - Asphalt Paving.
8. Section 32 1313 - Site Concrete Work.
9. Section 32 1236 - Seal for Bituminous Surfacing.

1.02 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating areas to be repaired.
- B. Product Data: Submit manufacturer's technical data for materials and products.

1.03 QUALITY ASSURANCE

- A. Comply with Standard Specifications for Public Works Construction, current edition.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Base course materials: Section 31 2326 - Base Course.
- B. Asphalt paving materials: Section 32 1216 - Asphalt Paving.
- C. Seal materials: Section 32 1236 - Seal for Bituminous Surfacing.
- D. Headers: Section 32 1216 - Asphalt Paving.

2.02 BITUMINOUS MATERIALS

- A. Provide materials and products of the class, grade or type indicated, conforming to relevant provisions of Section 203 - Bituminous Materials of the latest Standard Specifications for Public Works Construction.

PART 3 - EXECUTION

3.01 PAVEMENT REMOVAL

- A. Remove bituminous and concrete pavement in accordance with applicable provisions of Section 300 - Earthwork of the Standard Specifications for Public Works Construction.
- B. Pavement Heaved By Roots: Remove pavement to limits of distortion and expose roots. Trim roots to provide at least 12-inch clearance to pavement. Coordinate with OWNER's Tree Trimming Department for recommendations and approval prior to trimming roots.
- C. Remove protruding bituminous surfaces flush with the surrounding grade using a suitable tool or equipment so that adjacent finishes are not blackened.
- D. Remove raveled and depressed bituminous pavement to limits indicated or required.
- E. Saw cut existing improvements, trim holes and trenches in bituminous and concrete pavement to permit mechanical hand tampers to compact the fill.
- F. Remove broken concrete by saw cutting. If the required cut line is within 30 inches of a score or joint line or edge, cut and remove to the score, joint line, or edge.

3.02 EXCAVATING, BACKFILLING AND COMPACTING

- A. Conform to requirements in Section 31 2313 - Excavation and Fill; Section 31 2316 - Excavation and Fill for Paving; Section 31 2319 - Excavation and Fill for Structures; or Section 31 2323 - Excavation and Fill for Utilities, as required.
- B. Where subgrade or base is deemed to be unstable or otherwise unsuitable, excavate such materials to firm earth, and replace with a required material. Install and compact fill materials in accordance with the requirements of Section 31 2316 Excavation and Fill for Paving.

3.03 HEADERS

- A. Install headers along edge of bituminous surfacing abutting turf, earth, or planting area, unless indicated otherwise.
- B. Install headers so the bottom surface has continuous bearing on solid grade. Where excavation for headers is undercut, thoroughly tamp soil under the header. Compact backfill on both sides of header to the density of the adjacent undisturbed grade.
- C. Fasten headers in place with redwood or Douglas fir stakes of length necessary to extend into solid earth a minimum of 12 inches. Stakes shall be of sound material, neatly pointed, driven vertically, and securely nailed to headers. Space stakes, not to exceed 4 feet on centers with top of stakes set one inch below top of header. Provide a minimum of two 12d galvanized common nails through each stake.
- D. Remove existing headers where new surfacing is installed adjacent to existing surfacing.
- E. Install temporary headers at transverse joints of paving where continuous paving operations are not maintained.
- F. Provide additional stakes and devices as required to fasten headers.

3.04 BASE COURSE

- A. Unless otherwise indicated, base course shall be crushed aggregate base, fine grade, 3 inches thick or equal to thickness of the existing base, whichever is greater.
- B. Fill grade and compact as specified in Section 31 2200 - Grading.

3.05 RESURFACING

- A. Utility Trenches: Remove loose dirt and backfill with cement-sand slurry allowing for surfacing one inch thicker than existing. Resurface flush with existing adjoining

pavement installing the same type of materials and section provided in existing improvements.

- B. Other Areas: Other surface improvements damaged or removed shall be cut to a neat even line and excavated one inch below the bottom of the existing pavement. Resurface by following the original grades and installing the same type of materials provided in existing improvements.
- C. Where bituminous surfacing abuts concrete, masonry, walks or paving, tamp joint smooth, if necessary, as described above to obtain a uniformly even joint, true to line and grade. Tamp and smooth materials before asphalt cools.

3.06 REPAIRING AND RESEALING EXISTING SURFACES

- A. Preparation of Surfaces: Prior to filling cracks, clean existing bituminous surfacing of loose and foreign materials and coat with a film of asphalt emulsion.
- B. Repair of Existing Surfacing:
 - 1. Fill cracks 1/2 inch wide and less with RS-1 emulsion and washed plaster sand or other OEHS approved crack filler material. Cracks larger than 1/2 inch wide shall be filled with Type F/Sheet Mix Asphalt Concrete as specified. Cracks shall be filled to the level of adjacent surfacing.
 - 2. Where low areas, holes, or depressions occur in existing surfacing, refer to Section 32 1216; Asphalt Paving, Article 3.02. Use Type E/School Mix and feather edge joint flush to the level of adjacent surfacing.
- C. Testing: Flood test entire area in presence of the Project Inspector. Inspect area after waiting one hour. Entire area tested shall be free of standing water or puddles in excess of 0.01 foot. Practical field measurement: 0.01 foot = two quarters stacked.
- D. Surface Seal: After surface has been repaired and tested, install seal coat over entire area indicated. Surface seal shall be as specified in Section 32 1236 - Seal for Bituminous Surfacing.

3.07 CLEANING

- A. Remove all stains on the Project site and adjacent properties caused by or attributed to the Work of this section.
- B. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.08 PROTECTION

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

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Paving for playground, parking areas, areas between buildings surfacing adjacent to planting and turf areas as indicated.

B. Related Requirements:

1. Section 31 2200 - Grading.
2. Section 32 0117 - Pavement Repair.
3. Section 31 2326 - Base Course.
4. Section 32 1236 - Seal for Bituminous Surfacing.
5. Section 32 1313 - Site Concrete Work.

1.02 SUBMITTALS

A. Shop Drawings: Submit site plan indicating extent of paving and accessories.

B. Product Data: Manufacturer's technical data for materials and products.

1.03 QUALITY ASSURANCE

A. Comply with the following as a minimum requirement: Standard Specifications for Public Works Construction.

B. ADA related slopes shall be measured with a twenty-four-inch digital level.

1.04 PROJECT CONDITIONS

A. Information on Drawings or in soils report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.

B. A copy of the soils report is available for examination in the office of the ARCHITECT during regular office hours of the ARCHITECT.

PART 2 - PRODUCTS

2.01 BITUMINOUS MATERIALS

A. Provide materials of the class, grade, or type indicated on the Drawings, conforming to relevant provisions of Section 203 - Bituminous Materials of the Standard Specifications for Public Works Construction.

B. Asphalt Concrete Mix:

1. Paved slopes: Type III, D, PG-64-10.
2. Between buildings, playgrounds, parking and fire lanes: Type III, C3, PG-64-10.
3. Driveways for trash and delivery trucks: Type III, C3, PG-64-10 and Type III, B3, PG-64-10

2.02 HEADERS

A. Concrete: Per specification Section 32 1313 - Site Concrete Work.

PART 3 - EXECUTION

3.01 HEADERS

A. Concrete Headers:

1. Install headers along edge of bituminous surfacing as indicated on the Drawings.
2. Verify that gradients and elevations of base are correct. Maintain subgrade clean and in a smooth, compacted condition until the concrete is placed.
3. Construct forms, install steel reinforcement and place concrete as indicated on Section 32 1313 Site Concrete.

3.02 CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT

- A. Pavement Thickness: Unless otherwise indicated on Drawings or specified, install bituminous surfacing to a compacted thickness of 2 inches.
- B. Base course shall be as specified in Section 31 2326, Base Course.
- C. Surfaces of walls, concrete, masonry, or existing bituminous surfacing indicated to be in direct contact with installed bituminous surfacing shall be cleaned, dried and uniformly coated with an asphaltic emulsion film.
- D. Thicken edges of bituminous surfacing that do not abut walls, concrete, or masonry, and at edges joining existing bituminous surfaces. Remove headers at existing bituminous surfacing where new bituminous surfacing is to be installed. Thicken edges an additional 2 inches and taper to the indicated or specified thickness 6 inches back from such edges.
- E. At stairways, adjust thickness of paving such that the first tread is equal in height to all other treads.
- F. Provide adequate protection for concrete, planting areas, and other finish Work adjacent to areas indicated to receive bituminous surfacing.
- G. Placing:
1. Do not install bituminous surfacing when atmospheric temperature is below 40 degrees F; or when fog or other unsuitable weather conditions are present. Temperature of mixture at time of installation shall not be lower than 260 degrees F in warm weather or higher than 320 degrees F in cold weather.
 2. Where 2-inch or 3-inch thick surfacing is indicated or specified, install surfacing in one course. Where surfacing is indicated or specified 4 inches or more in thickness, except for thickened edges, install bituminous surfacing in courses of approximately equal thickness, each course not exceeding 2 ½ inches in thickness.
- H. Stakes or Screeds: Provide grade or screed stakes spaced not more than 15 feet apart in flow lines with grades of less than one percent. Continuous screeds may be provided instead of stakes.
- I. Spreading: Install bituminous surfacing in a manner to cause least possible handling of mixture. In open areas and wherever practicable, install by mechanical means with a self-propelled mechanical spreader. In confined or restricted areas, install mixture with hot shovels and rakes, and smooth with lutes.
- J. Joints: Provide vertical joints between successive runs. Install joints true to line, grade, and cross section. Lapped joints are not permitted.
- K. Rolling:
1. Finish roll with a self-propelled tandem roller weighing at least 8 tons. Break down roll with a self-propelled roller weighing between 1 ½ tons and 8 tons.

2. Roll in a manner that preserves flow lines and the established finished grades. Break down roll in areas adjacent to flow lines parallel to flow lines. Break down roll after bituminous surfacing is installed without shoving or cracking of mixture under roller. Continue finish rolling until surfacing is unyielding, true to grade, and meets requirements for specified smoothness. Areas inaccessible to finish roller may be finish rolled with breakdown roller or tamped with hot tamping irons and smoothed with hot smoothing irons, hand roller or asphalt plate compactor.
3. Where bituminous surfacing abuts concrete, masonry, walks or paving, tamp joint smooth, if necessary, as described above to obtain a uniformly even joint, true to line and grade. Tamp and smooth to properly compact.
4. Compacted bituminous surfacing shall be provided with a bulk specific gravity of at least 2.31 when tested in accordance with ASTM D1188.

L. Allow bituminous surfacing a thirty day curing time before applying surface seal.

3.03 TOLERANCE

- A. Smoothness: Surface of bituminous surfacing after rolling, shall be even, smooth and uniform in texture with no voids or rock pockets, free of roller marks or other irregularities, and not varying by more than 0.03 foot, except at local depressions or raised areas as indicated, when a 10-foot straightedge is placed on surface.
- B. Grade: Finished grade shall not vary more than 0.02 foot above or below required grade. Variations within prescribed tolerance shall be compensating so that average grade and cross-section are provided.

3.04 TESTING

A. Asphalt Pavement to Receive Solar Reflective Coating:

1. After asphalt paving has been installed and after a 24 hour period, flood test entire area in presence of the Project Inspector. Inspect area after waiting one hour. Entire area tested shall be free of standing water or puddles in excess of 0.01 foot. Practical field measurement 0.01 foot = two quarters stacked. Repair areas of standing water or puddles and flood test locally; install surface seal and retest as necessary.
2. No seals are to be applied to areas of asphalt paving that are to receive solar reflective coatings.

3.05 SURFACE SEALING

- A. Refer to Section 32 1236 - Seal for Bituminous Surfacing.
- B. Where indicated, provide multiple coats of surface seal to existing bituminous surfacing.
- C. Where new bituminous surfacing joins existing bituminous surfacing, overlap surface seal a minimum of 12 inches onto existing bituminous surfacing.

3.06 PROTECTION

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

3.07 CLEANUP

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

END OF SECTION

SECTION 32 12 36

SEAL FOR BITUMINOUS SURFACING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Surface sealer over bituminous surfacing.

B. Related Requirements:

1. Section 32 0117 - Pavement Repair.
2. Section 32 1216 - Asphalt Paving.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's product information and application procedures for bituminous surfacing.

1.03 QUALITY ASSURANCE

- A. Comply with the Standard Specifications for Public Works Construction, current edition.
- B. Agitate bulk materials during transport.

1.04 MAINTENANCE

- A. Extra Materials: Provide 10 gallons in unopened containers.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Provide one of the following surface seals:

Product Name	Manufacturer
1. Guard-Top	CALMAT / Industrial Asphalt
2. Over Kote	Diversified Asphalt Product
3. Park Top	Western Colloid Products
4. Sure Seal	Asphalt Coating Engineering
5. Super Drive Top.	SAF- T Seal. Inc.
6. Equal.	

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

- A. Thoroughly wash surfaces with water to remove dirt, debris, excessive oil and grease, or other foreign matter.

3.02 APPLICATION

- A. Install seal coat in strict accordance with manufacturer's written directions and recommendations.

- B. Install two coats of surface seal to new bituminous surfacing. First coat shall be installed before flood testing. Clean surface and allow to dry before installing second coat. Second coat shall be installed after bituminous surfacing has passed flood test.
- C. Where new bituminous surfacing is installed adjacent to existing bituminous surfacing, overlap surface seal a minimum of 12 inches onto existing bituminous surfacing.
- D. Where existing bituminous surfacing is indicated to be patched and sealed, install two coats of surface seal after patching. Refer to Section 32 1216 - Asphalt Paving.

3.03 PROTECTION OF SURFACES

- A. Protect sealed and unsealed surfaces from damage and traffic during performance of the Work of this section and until surface seal has thoroughly set and cured. Do not permit traffic of any kind for at least 24 hours after completion of installation.
- B. Protect the Work of this section until Substantial Completion.

3.04 TESTING

- A. OWNER reserves the right to obtain samples, perform tests to ensure compliance with the Specifications, and to review weight slips and invoices of materials delivered to the Project site.
- B. After first coat of surface seal has been installed and after a 24-hour period, flood test entire area in presence of the Project Inspector. Inspect area after waiting one hour. Entire area tested shall be free of standing water or puddles in excess of 0.01 foot. Practical field measurement: 0.01 foot = two quarters stacked. Repair areas of standing water or puddles and flood test locally; install surface seal and retest as necessary.

3.05 CLEAN UP

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

END OF SECTION

SECTION 32 13 13

SITE CONCRETE WORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: On-site concrete work:

1. Portland cement concrete pavement, driveways, curbs, gutters and mowing strips.
2. Portland cement concrete paving shall be stable, firm, and slip resistant and shall comply with CBC Sections 11B-302 and 11B-403.

B. Related Requirements:

1. Section 03 1000 – Concrete Formwork.
2. Section 31 2200 – Grading.
3. Section 31 2316 - Excavation and Fill for Pavement.
4. Section 31 2326 - Base Course.
5. Section 32 1216 - Asphalt Paving.
6. Section 33 4000 - Storm Drainage Utilities.

1.02 REFERENCES

A. Structural work, such as retaining walls, planter walls, cast-in-place benches, equipment pads, and footings for playground equipment, fences, walls, shade structures and flagpoles shall conform to the following Sections:

B. Flatwork, such as walkways, driveways, ramps and steps on grade, swales, curbs, mow strips and utility related concrete, conform to:

1. Standard Specifications for Public Works Construction, the “Green book”, except reclaimed aggregates and processed miscellaneous base are not allowed.

C. National Ready Mixed Concrete Association (NRMCA):

1. Checklist for the Concrete Pre-Construction Conference.

1.03 QUALITY ASSURANCE

A. Source Limitations for Exposed Concrete: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties. Secure material required for the duration of the project as needed to ensure consistent quality in appearance.

B. Pre-Installation Conference:

1. CONTRACTOR shall use the NRMCA “Checklist for the Concrete Pre-Construction Conference” as the meeting agenda.

C. Mockup:

1. Build 8 feet by 8 feet mockups of full-thickness sections of concrete paving using processes and techniques intended for use on permanent work, including curing procedures.

2. Build mockups to demonstrate typical joints; surface finishes and standard of workmanship.
 3. Obtain ARCHITECT's approval of mockup before proceeding with work of this Section.
 4. Mockup shall remain through completion of the work for use as a quality standard for finished work.
 5. Remove mockup when directed by the OAR.
- D. Field applied primers, paintings, sealers, sealants, caulking, leveling and patching compounds, crack/joint repair compounds adhesives and similar products shall be approved by the OWNER's Office of Environmental Health and Safety (OEHS).
- E. Accessible walking surface and ADA related slopes shall be measured with a twenty-four-inch digital level.

1.04 SUBMITTALS

- A. Flatwork: Submit mix design in conformance to the Green book.
- B. Shop Drawings: Submit drawings indicating the locations of concrete joints, including construction joints, expansion joints, isolation joints, and contraction joints.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Store cement and aggregate materials so to prevent their deterioration or intrusion by foreign matter. Deteriorated or contaminated materials shall not be furnished.
- B. Packaged materials shall bear the manufacturers and brand name label and shall be stored in their original unbroken package in a weather tight place until ready for use in the work.
- C. Avoid exposure of reinforcing steel bars, wire, and wire fabric to dirt, moisture or conditions harmful to reinforcing.
- D. Reinforcing steel bars, wire, and wire fabric shall be stored on the Project site to permit easy access for examination and identification of each shipment. Material of each shipment shall be separated by size and shape.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Structural Work: Conform to the applicable requirements of the following Sections, except as otherwise specified:
- B. Flatwork: Conform to the applicable requirements of the Green book, Section 201, except as follows:
1. Water/cement ratio for concrete flatwork shall be 0.50 maximum.
 2. Base course shall conform to Section 32 3226 Base Course.
 3. Reclaimed concrete material shall not be used.
- C. Fabricated from 6061-T6 aluminum, clear anodized.
1. Fixed Angle Series

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that gradients and elevations of base are correct. Maintain subgrade clean and in a smooth, compacted condition until the concrete is placed.
- B. Maintain subgrade in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. Earth surface shall be kept moist by frequent sprinkling up to the time of placing concrete.

3.02 CONSTRUCTION OF FORMS

- A. Flatwork Forming: Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 4 stakes per form placed at intervals not to exceed two feet. Use additional stakes and braces at corners, deep sections, and radius bends, as required. Use clamps, spreaders, and braces where required to ensure rigidity in the forms.
- B. Wall Formwork: Forms shall be constructed to conform to final concrete shape, lines and dimensions of members required by Drawings and Specifications. Forms shall be sufficiently tight to prevent leakage of concrete and properly braced or tied together to maintain position and shape.

3.03 STEEL REINFORCEMENT INSTALLATION

- A. Fabricate bars of the indicated sizes and bend and form to required shapes and lengths by methods not injurious to materials. Do not heat reinforcement for bending. Bend bars No. 6 size and larger in the shop only. Bars with unscheduled kinks or bends are not permitted.
- B. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- C. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces, and lace splices with wire.
- D. Clean reinforcement of loose rust and mill scale, earth, or bond-reducing materials.

3.04 PREPARATION FOR CONCRETE PLACEMENT

- A. Surfaces to receive concrete shall be free of debris, standing water, and any other deleterious substances before start of concrete placing.
- B. Do not place concrete until forms, reinforcement, pipe, conduits, outlet boxes, anchors, sleeves, bolts, and other embedded materials are securely fastened in place. Maintain a minimum of two inches clearance between said items and any part of the concrete reinforcement.
- C. Adjust pull boxes, meter boxes, valve covers and manholes to proposed finish grade prior to placement of concrete. Anchor bolts shall be accurately set and maintained in position by templates while being embedded in concrete.
- D. Clean thoroughly the surfaces of metalwork to be in contact with concrete, remove dirt, grease, loose scale and rust, grout, mortar, and other foreign substances before the concrete is placed.
- E. Moisten sub base to provide a uniform dampened condition at time concrete is placed.

3.05 CONCRETE PLACEMENT

- A. Place, compact, screed, float and trowel concrete as indicated in Section 03 3000 Cast-in-Place Concrete.
- B. Finish: After straight edging, when most of the water sheen has disappeared and just before the concrete hardens, finish the surface with a wood or magnesium float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool

marks. Produce a scored surface by booming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

1. Provide medium broom finish on surfaces up to six percent slope by striating surface 1/32 to 3/64 inch deep with a soft bristle broom across concrete surface to provide a uniform fine line texture.
2. Provide heavy broom finish on surfaces over six percent by striating surface 1/16 inch to 1/8 inch deep with a stiff-bristled broom.

3.06 JOINTS

- A. Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated. Align curb, gutter, and sidewalk joints.
- B. Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour.
 1. Continue steel reinforcement across construction joints unless otherwise indicated on the Drawings.
 2. Provide tie bars at sides of paving strips where indicated on the Drawings.
 3. Butt Joints: Use bonding agent or epoxy-bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated on the Drawings.
- D. Expansion Joints:
 1. Provide premolded joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together. Extend expansion joint fillers full-width and depth of joint, and 1/4" below finished surface where joint filler is indicated. If no joint sealer is indicated place top of premolded joint filler flush with top of concrete or curb.
 2. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- E. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints to a depth equal to at least one-fourth of the concrete thickness, as follows:
 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Remove grooving-tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

- 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- F. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Remove edging-tool marks on concrete surfaces.
- G. Where concrete is to be cast against old concrete, (greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by sand-blasting, exposing the aggregate. The hardened surface shall be cleaned of latent foreign material and washed clean, prior to the application of an epoxy bonding agent.

3.07 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

- A. Formed Curb and Gutter: Place concrete to the required section in a single lift. Consolidate concrete using approved mechanical vibrators. Finish curve shaped gutters with a standard curb mule or concrete slip formed curb paving equipment.
- B. Concrete Finishing: Float and finish exposed surfaces with a smooth wood float until true to grade and section and uniform in texture. Brush floated surfaces with a fine-hair brush using longitudinal strokes. Round the edges of the gutter and top of the curb with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the front curb surface, while still wet, in the same manner as the gutter and curb top. Finish the top surface of gutter to grade with a wood float.
- C. Surface and Thickness Tolerances: Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.08 TRACK AND FIELD CONCRETE WORK

- A. Provide a Conformance Survey for concrete curbs, bands, drains, edge of paving dimensions and elevations in accordance with Section 32 1823 Asphalt Paving for Synthetic Running Track Surfacing.
- B. Corrective Measures: Determine If the planarity, cross slopes, elevations or general specifications have not been met submit corrective measures for the ARCHITECT's and OWNER's review and approval. Once the corrective measures have been completed the track surfacing contractor shall submit a notification accepting the concrete work.

3.10 CLEAN UP

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

3.11 PROTECTION

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

END OF SECTION

SECTION 32 17 26

DETECTABLE WARNING SURFACING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Precast concrete detectable warning tile pavers installed on mortar bed over concrete slab.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 31 2200 – Grading.
3. Section 31 2316 - Excavation and Fill for Pavement.
4. Section 31 2326 - Base Course.
5. Section 32 1216 - Asphalt Paving.
6. Section 32 1313 – Site Concrete.

1.02 REFERENCES

A. ASTM International (ASTM):

1. ASTM A1046- Standard Specification for Steel Sheet, Zinc-Aluminum-Magnesium Alloy-Coated by the Hot-Dip Process.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C67 – Standard Methods of Sampling and Testing Brick and Structural Clay Tile.
4. ASTM C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
5. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C920 – Standard Specifications for Elastomeric Joint Sealants.
8. ASTM C936 - Standard Specification for Solid Concrete Interlocking Paving Units.

B. The Masonry Society (TMS); American Concrete Institute (ACI), and American Society of Civil Engineers (ASCE):

1. TMS 602 / ACI 530.1 / ASCE 6 - Specifications for Masonry Structures.

C. Tile Council of North America (TCNA):

1. TCNA Handbook for Ceramic, Glass, and Stone Tile Installation.
 - a. TCNA F101 - Mortar Installation.
 - b. TCNA EJ171 - Movement Joints.

D. American National Institute Standards (ANSI):

1. ANSI A118.4 - Specifications for Modified Dry-Set Cement Mortar.
2. ANSI A118.7 – Specifications for High Performance Cement Grouts for Tile

Installation.

1.03 REGULATORY REQUIREMENTS

- A. Detectable warning surfacing shall conform to:
 - 1. Title 28 Code of Federal Regulations, Part 36, Subpart D: 2010 ADA Standards for Accessible Design, 2010 Standards for Public Accommodations and Commercial Facilities: Title III.
 - 2. CBC Section 11B-705, Detectable Warnings and Detectable Directional Texture.
- B. Installed detectable warning pavers shall provide consistent side to side and end to end spacing that complies with the regulatory requirements.

1.04 PROJECT CONDITIONS

- A. Weather Limitations for Mortar and Grout:
 - 1. Cold Weather Requirements: The cold weather construction provisions of TMS 602 / ACI 530.1 / ASCE 6 shall be implemented when the ambient temperature falls below 40F°.
 - 2. Hot Weather Requirements: The hot weather construction provisions of TMS 602 / ACI 530.1 / ASCE 6 shall be implemented when the ambient temperature exceeds 100° F or 90° F with a wind velocity greater than 8 mph.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Products covered under this Section shall be produced by a single manufacturer, unless otherwise specified, with a minimum of five years proven production experience.
- B. Installer Qualifications: Installer shall have a minimum of three years proven construction experience with the work specified in this Section.
- C. Pre-Installation Conference: CONTRACTOR shall coordinate and conduct pre-installation conference in conformance to Section 01 3119 Project Meetings.
- D. Field applied primers, paintings, sealers, adhesives and cleaners shall be approved by the OWNER's Office of Environmental Health and Safety (OEHS).

1.06 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including installation instructions maintenance recommendations.
- B. Shop Drawings: Submit layout drawings showing pattern of detectable warning pavers and provide details at curbs and adjacent construction. Indicate pavers requiring cutting.
- C. Material Test Reports: Submit current test reports from an independent testing laboratory indicating that materials used comply with the specification requirements and the proposed products meet the properties specified.
- D. Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns. Color will be selected by ARCHITECT.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Protect detectable warning pavers during shipment, storage and construction against damage. Store a minimum of 4 inches off the ground on pallets in a dry location and cover with polyethylene to protect from contact with materials which would cause staining or discoloration.

1.08 WARRANTY

- A. Detectable Warning Pavers shall remain free from defects for a period of five years.
- B. CONTRACTOR shall warrant that his work will remain free from defects of labor and materials used in conjunction with his work for three years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Hanover Architectural Products.
- B. StepStone, Inc.
- C. Tile Tech Pavers Inc.
- D. Wausau Tile Co.
- E. Equal.

2.02 MATERIALS

- A. Detectable Warning Paver Materials:
 - 1. Portland Cement: In conformance with ASTM C150.
 - 2. Aggregates: In conformance with ASTM C33, cleaned and properly graded to size. Aggregates shall be a blend from 200 mesh to 5/8 inch.
 - 3. Coloring: Pigments used shall be inorganic, resistant to alkalinity and used per manufacturer's recommendations.
 - 4. Color Blending: Factory-blend pre-cast paver that has a natural color range so products taken from one batch will have the same range as products from a separate batch.
 - 5. Cleaner: Liquid neutral chemical cleaner with pH factor between 7 and 8, of formulation recommended by sealer manufacturer and approved by OWNER's OEHS.
 - 6. Sealer: Colorless, slip and stain resistant penetrating or acrylic sealer with pH factor between 7 and 10 that does not affect color or physical properties of precast paver surface. Sealer shall be approved by OWNER's OEHS.
- B. Setting Bed, Mortar and Miscellaneous Materials:
 - 1. Setting Bed:
 - a. Portland Cement: In conformance to ASTM C150.
 - b. Aggregate: Sand in conformance to ASTM C144. Sand shall be clean, graded and pass a 16 mesh screen.
 - c. Reinforcing Mesh: In conformance to ASTM A1046. 2 inches X 2 inches 16/16.
 - 2. Mortar: In conformance to ANSI A118.4.
 - 3. Grout: In conformance to ANSI 118.7. Grout colors: selected by the ARCHITECT from the manufacturer's complete color range.
 - 4. Water: Potable and free from deleterious substances.
 - 5. Mortar and Grout Mixes: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer

speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimal performance characteristics. Discard mortars and grout if they have reached their initial set before being used.

6. Primer: As recommended by the mortar material manufacturer and approved by OWNERS's OEHS.
7. Sealant and backing materials: In conformance to ASTM C920, Type T, joints subject to pedestrian and vehicular traffic and approved by OWNERS's OEHS.

2.03 DETECTABLE WARNING PAVER FABRICATION

- A. Detectable Warning Pavers: Factory precast concrete pavers with raised truncated domes conforming to CBC Section 11B-705.
 1. Dome Size: Base diameter of 0.90 inch minimum and 0.92 inch maximum, a top diameter of 0.45 inch minimum and 0.47 inch maximum and a height of 0.20 inch.
 2. Dome Spacing: Truncated domes in a detectable warning surface shall have a center-to-center spacing of 2.3 inches minimum and 2.4 inches maximum, and a base-to-base spacing of 0.65 inch minimum, measured between the most adjacent domes on a square rigid.
 3. Color: In conformance to CBC section 11B-705.1.1.3.
 4. Contrast: Detectable warning materials shall provide a 70 percent minimum visual contrast with adjacent walking surfaces.
 5. Resiliency: Detectable warning surfaces shall differ from adjoining surfaces in resiliency or sound-on-cane contact.
- B. Physical Properties:
 1. Size: Nominal 12 inches x12 inches.
 2. Thickness: Nominal 2 inches.
 3. Sizing Dimensions: Shall not differ by more than 1/16 inch from width, height, length or thickness. Unit shall conform to a true plane and not differ by more than 1/16 inch in either concave and/or convex warpage.
 4. Compressive Strength: Shall not be less than 8,000 psi per ASTM C140.
 5. Water Absorption: Shall not be greater than 6% per ASTM C936 or ASTM C140.
 6. Freeze/Thaw: Durability of the paver shall meet the freeze/thaw tests per Section 8 of ASTM C67 and shall have no breakage and not greater than 1 % loss in dry weight of any individual unit when subject to 50 cycles of freeze/ thaw.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine concrete base and verify no sealers, curing compounds or other coatings have been be applied. If present remove in accordance to paver manufacturer.
- B. Concrete base shall have a fine broom finish or wood float finish. If not provided scarify mechanically as recommended by paver manufacturer.
- C. Remove debris and loose particles and sweep concrete surfaces.

1.02 SETTING BED

- A. Installation of mortar bed shall conform to TCA F101.
- B. Install red wood float strips so that a straight edge can reach the maximum edges of the intended mortar bed. Verify top of float strips are at the correct elevation to allow a flush installation of the detectable warning pavers with the adjacent surfaces.
- C. Moisten concrete base and float strips.
- D. Apply a thin, continuous coat of pure Portland cement slurry on the concrete surface or dust a thin layer of dry Portland cement on the concrete and wet it. Broom to completely coat the concrete surface with a thin and uniform coating.
- E. Place welded wire fabric on chairs or spacers or small mounds of mortar to hold the reinforcement at the center of the setting bed. Welded wire fabric shall overlap a minimum of one mesh.
- F. Mix and apply mortar setting bed material in accordance with the manufacturer's instructions to a thickness of 1-1/4 inches. Trowel mortar between the float strips compacting the mortar as much as possible.
- G. Using the float strips as the guide cut off the excess mortar placing the excess further down the area to be floated.
- H. While the mortar bed is still plastic or has not cured remove the float strips and fill the grooves with fresh mortar.

1.03 PAVER INSTALLATION

- A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
- B. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
- C. Lay pavers in pattern on mortar bed as indicated on the Drawings.
- D. Apply mortar using the flat side of the trowel first. Move notched side of trowel in a parallel pattern allowing for air to escape. Apply bod coat over the entire setting surface including grout joints. "Back-butter" pavers with 1/8 inch thick mortar for full mortar to mortar contact.
- E. Position paver on mortar bond coat using a slight back and forth motion. "Squeeze up" mortar minimum 1/8 inch in grout joints along tile edges and corners eliminating air voids.
- F. Level pavers using a straight edge or taught string.
- G. Placement Tolerances:
 - 1. Maximum of 1/16 inch height variation between adjacent pavers.
 - 2. Individual pavers shall not vary more than 1/16 inch from level across width of the paver.
 - 3. Paved areas shall not vary more than 1/4 inch from level in a distance of ten feet measured at any location and in any direction.
 - 4. The surface elevation of pavers shall be 1/8 inch to 1/4 inch above adjacent drainage inlets.

3.04 EXPANSION AND CONTROL JOINTS

- A. Locate expansion and control joints as indicated on the Drawings and where pavers are in contact with dissimilar materials such as curbs, concrete pavement and walls.
- B. Joints shall be uniform, straight of 3/16 inch wide.
- C. Install in accordance with TCA Detail EJ171,
- D. Carry joint completely through the assembly to surface.
- E. Keep joints clear of mortar setting materials and grout.
- F. Apply backer materials and sealant in joints following manufacturer's instructions.

3.05 GROUTING

- A. Follow grout manufacturer's instructions.
- B. Dampen grout joints prior to grout insertion.
- C. Install grout using a grout bag or a tuck pointer. Tool the joint with a round tool ("spoon") or brick jointer.
- D. Allow excess grout to set up briefly until it can be swept off using a stiff brush or broom.
- E. For final cleaning use cheesecloth, clean damp sponge or when necessary, steel wool. Do not use any acidic cleaners to remove excess grout or grout haze.
- F. Remove, scrub and wash clean mortar stains and all other types of soiling from exposed paver surfaces.
- G. Apply sealer in accordance with manufacturer's directions.

3.06 CLEAN UP

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

3.07 PROTECTION

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

END OF SECTION

SECTION 33 40 00

STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes storm drainage piping; sub-surface drains; metal covers, grates and frames; catch basins; box culverts; manholes, and BMPs.
 - 1. Best Management Practices (BMPs):
 - 2. Closed-circuit television inspection of storm drain lines.

1.02 RELATED REQUIREMENTS

- A. Section 31 2323 - Excavation and Fill for Utilities.
- B. Section 32 0117 - Pavement Repair.
- C. Section 32 1313 - Site Concrete Work.

1.03 DEFINITIONS

- A. AASHTO: American Association of State Highway and Transportation Officials.
- B. ASME: American Society of Mechanical Engineers.
- C. ASTM: American Society for Testing and Materials.
- D. BMP: Stormwater Best Management Practice.
- E. CBC: California Building Code.
- F. CCTV: Closed-Circuit Television.
- G. DET: Detention BMP.
- H. DWV: Drain, Waste, and Vent.
- I. FILT: Filter BMP.
- J. GS: Gravity Separator.
- K. HDPE: High Density Polyethylene.
- L. IAPMO: International Association of Plumbing and Mechanical Officials.
- M. IOR: Inspector of Record.
- N. NPS: Nominal Pipe Size.
- O. OAR: OWNER's Authorized Representative.
- P. PE: Polyethylene.
- Q. Post Construction BMP: Devices installed by the CONTRACTOR for storm water management to be left on site after construction completion.
- R. PP: Polypropylene.
- S. PVC: Poly Vinyl Chloride.
- T. RET: Retention.
- U. SDR: Standard Dimensions Ratio.
- V. VEG: Vegetative.

W. OWNER: Los Angeles Unified School District.

X. SWPPP: Storm Water Pollution Prevention Plan.

1.04 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):

1. ASHTO M 252: Geotextile Specification for Highway Applications.
2. AASHTO M 294: Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter.
3. AASHTO M 330: Standard Specification for Polypropylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter.

B. American Society for Testing and Materials International (ASTM):

1. ASTM A888: Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
2. ASTM C14: Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
3. ASTM C443: Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
4. ASTM C564: Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
5. ASTM C76: Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
6. ASTM C857: Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
7. ASTM C858: Standard Specification for Underground Precast Concrete Utility Structures.
8. ASTM C891: Standard Practice for Installation of Underground Precast Concrete Utility Structures.
9. ASTM D2564: Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
10. ASTM D2665: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
11. ASTM D2855: Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
12. ASTM D3034: Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
13. ASTM D3212: Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
14. ASTM D448: Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
15. ASTM F1866: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Schedule 40 Drainage and DWV Fabricated Fittings.
16. ASTM F2306: Standard Specification for 12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.

17. ASTM F2418: Standard Specification for Polypropylene Corrugated Wall Stormwater Collection Chambers.
18. ASTM F2764: Standard Specification for 6 to 60 in. [150 to 1500 mm] Polypropylene (PP) Corrugated Double and Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications.
19. ASTM F2787: Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers.
20. ASTM F2881: Standard Specification for 12 to 60 in. [300 to 1500 mm] Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications.
21. ASTM F2922: Standard Specification for Polyethylene Corrugated Wall Stormwater Collection Chambers.
22. ASTM F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
23. ASTM F656: Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
24. ASTM F794: Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

C. Cast Iron Soil Pipe Institute (CISPI):

1. CISPI 301: Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
2. CISPI 310: Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

D. The International Association of Plumbing and Mechanical Officials (IAPMO):

1. IAPMO IS 6: Hubless Cast Iron Sanitary and Rainwater Systems - Installation Standards.

E. Standard Specifications for Public Works Constructions (Greenbook):

1. Section 202: Masonry Materials.
2. Section 206: Miscellaneous Metal Items.
3. Section 207: Pipe.
4. Section 208: Pipe Joint Types and Materials.
5. Section 210: Paint and Protective Coatings.
6. Section 306: Underground Conduit Construction.

1.05 SUBMITTALS

- A. Shop Drawings: Submit site plan denoting locations of lines, valves, and appurtenances.
- B. Product Data: Manufacturer's catalog data for all required materials. Include technical data for accessories, information concerning gaskets, joints and couplings.
- C. Certificates: Certificates attesting that tests set forth in referenced publication have been performed and the results required by design have been met.
- D. Closeout Documents: At Substantial Completion submit to the OAR two CD's and one hard copy of the documents indicated in paragraphs 1 through 5 below:
 1. Maintenance Log: Provide Microsoft Excel Spreadsheet including the following information:

- a. Maintenance log and upkeep records of the installed Post Construction BMPs. Include the following headers as a minimum: "Date of Service", "Location of BMP", "Type of Maintenance or Service", "Notes", "Next Scheduled Preventive Maintenance Due", and "Inspector Signature".
 - b. Maintenance Requirements: Include the following headers as a minimum: "BMP Description", "Location of BMP and Map Grid Location" and "Type of Maintenance or Service Needed", i.e.; weekly, monthly, quarterly, etcetera. "Stock No.", "Manufacturer Contact Information", along with "Frequency" namely: weekly, monthly, quarterly, etcetera and "Special Instructions".
2. Maintenance Manuals: Provide Maintenance Manual for storm drainage BMP components installed along with requirements, replacement or maintenance schedule and plans with the location of each BMP component. This manual shall include product information cut sheet, shop drawings, vendor information for each component and warranty.
3. Record drawings: 'As-Built' site plan(s) showing Post Construction BMP. Provide a copy of marked record set with red pencil identifying any variations from design documents.
4. Training Documentation:
 - a. OWNER attendees sign off training sheet.
 - b. Two DVD's of materials covered in the training and components installed.
5. Post-Construction BMP Maintenance Plan: Submit complete Plan per Attachment "A", edit per As-Built conditions and provide missing information.
6. Records of Closed-Circuit Television Inspection: At Substantial Completion submit to the OAR three DVD's of Closed-circuit television inspections performed. Include the following information:
 - a. Electronic Media Recordings: Visual and audio record of the entire length of pipe. For existing laterals identify problem areas, such as roots, cracks, fractures, broken pipe, and other unusual conditions found.
 - b. Digital Photographs of the pipe condition, connections, points of interest and defects found. Indicate distance of defects to a point of reference such as face of building or mainline. Provide the Digital Photographs after fixing the defective pipes.
 - c. Inspection Log: Provide written report including:
 - 1) Date and time of inspection.
 - 2) Name of School, Project, CONTRACTOR, and operator name.
 - 3) Location, material and size of pipe.
 - 4) Description of defects found and attempts to fix them.

1.06 QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement: Standard Specifications for Public Works Construction, current edition.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic products, pipes, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.

- C. Handle all products according to manufacturer's written rigging instructions.

1.08 TRAINING OF OWNER PERSONNEL

- A. At Substantial Completion and when the storm drainage system is fully operational, knowledgeable representatives from the CONTRACTOR and manufacturer(s) of the components specified and installed at the site shall provide up to 8 hours of training. Date, time and location for the training shall be coordinated through the project OAR. Have OWNER attendees sign off training sheet and provide a copy to the OAR.
- B. Training period shall cover but not be limited to the following:
 - 1. Explain the operation of storm drainage system and its design intent.
 - 2. Explain the maintenance requirements of every component of the system.
 - 3. Provide recommendations of practices to minimize or eliminate negative impact on the system.
 - 4. Provide maintenance schedule as recommended by the manufacturers for every component and review it with OWNER's Maintenance and Operations staff.
 - 5. Conduct a site walk, identify every component of the system and demonstrate its operation.
 - 6. Training shall be conducted with the use of Maintenance log and Maintenance manual.

1.09 SURPLUS MATERIALS

- A. Provide enough additional materials for each component of BMP that requires replacement or service during the first year.

PART 2 – MATERIALS AND PRODUCTS

2.01 PIPING MATERIALS

- A. General: Minimum 5 feet away from building boundaries. For piping within 5 feet from building boundaries, and interior piping refer to Division 22 plumbing sections. Provide piping system in conformance with Section 207 - Pipe and Section 208 - Pipe Joint Types and Materials of the Standard Specifications for Public Works Construction. All Soil-tight pipes shall be provided with joints that are function of opening size, channel length, and backfill particle size. A backfill material containing a high percentage of fine-graded soils requires investigation for the specific type of joint to be used to guard against soil infiltration, including the requirement for fabric-wrapped joints.
- B. Corrugated, Dual Wall, High Density Polyethylene Drainage Pipe (HDPE):
 - 1. Corrugated PE Drainage Pipe and Fittings NPS 4 to NPS 10: AASHTO M 252, Type S (double-wall) with smooth waterway for coupling joints.
 - 2. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294 or ASTM F2306, Type S (double-wall) with smooth waterway for coupling joints.
 - 3. Approved manufacturer: ADS, Hancor, JM Eagle, or equal.
- C. Corrugated, Dual or Triple Wall, Polypropylene Pipe (PP):
 - 1. Corrugated PP Drainage Pipe and Fittings NPS 12 to NPS 60: ASTM F2764, ASTM F2881, or AASHTO M 330, Type S (double-wall) or Type D (triple-wall), for respective diameters. Provide coupling joints with smooth waterway.
 - 2. Approved manufacturers: ADS, Prinsco, or equal.

D. PVC (Poly Vinyl Chloride) Schedule 40 DWV Pipe:

1. Conform to ASTM D2665, ASTM F794, and ASTM F1866.
2. Installer of PVC Schedule 40 DWV piping system shall carry ASTM D2855 and ASME B31.3 qualification. Installer shall provide proof of these qualifications to IOR prior to commencing work.
3. Containers for solvent and primer shall be clearly marked with manufacturer's data. Solvent and primer shall not be more than one year old. The safety placards must be visible.
4. Blue or red-hot glue shall not be used.
5. Approved manufacturers and products:
 - a. Pipe: Charlotte pipe and foundry, Harvel Plastics Inc., JM Eagle, Spears Manufacturing Company, or equal.
 - b. Primer: Weld-On P-70 by IPS, Conforming to ASTM F656.
 - c. Cement: Weld-On 711 (gray) by IPS, Conforming to ASTM D2564.

E. PVC (Poly Vinyl Chloride) SDR-35 Pipe, 6" through 15":

1. Conform to ASTM D3034.
2. Gasketed Joints: Elastomeric gasket joints conforming to ASTM D3212.
3. Gaskets: Chloroprene conforming to ASTM F477.
4. Approved manufacturers: Charlotte pipe and foundry, Harvel Plastics Inc., JM Eagle, Spears Manufacturing Company, or equal.

2.02 BEDDING MATERIAL FOR PIPE

- A. General: Conform to the requirements of Section 31 2313 - Excavation and Fill or Section 31 2323 - Excavation and Fill for Utilities, as required.
- B. Approved manufacturers and products:
 1. Propex Fabrics, Inc.: Geotex 451.
 2. TenCate Geosynthetics Americas: Mirafi 140N.
 3. US Fabrics, Inc.: 120NW.
 4. Equal products.

2.03 PERFORATED SUBSURFACE DRAIN PIPE

- A. Perforations shall be symmetrically located within a maximum arc of 160 degrees. Perforations shall provide a total open area of at least 0.3 square inches per linear foot of pipe, with a minimum of one perforation per linear foot, except for joint areas. Perforation shall be either holes or slots. Hole diameters of 1/4-inch minimum to 1/2-inch maximum. Width of slots of 1/8-inch minimum to 5/16-inch maximum with slot length not exceeding 5 inches.
- B. Aggregate Around Perforated Pipe shall be 6 inches of gravel containing no particles finer than a 1/2-inch to 3/4-inch sieve opening size.

2.04 STORMWATER TREATMENT SYSTEMS /BMPS

- A. VEG: Proprietary Biotreatment Devices, approved manufacturers and products:
 1. BioClean: Modular Wetlands System.
 - a. Infiltration media shall be ARCOSA.

2. Contech: Filterra Bioretention Systems.
 - a. Infiltration media shall be Filterra Media consist of a combination of natural sand, gravel, and organic materials.
3. DeepRoot Urban Landscape: Silva Cell 2.
4. Oldcastle: BioPod Underground.
 - a. Infiltration media shall be StormMix.
5. StormTree: Tree Filter System.
 - a. Grates shall be Hot-dip galvanize steel.
 - b. Infiltration media shall be CocoGro Coir Fiber.
6. Equal products.

2.05 MANHOLES

- A. Provide round reinforced concrete manhole with an H-20 traffic rated hatch & solid cover of minimum 30-inch in diameter with holes of maximum ½-inch in diameter.

2.06 MISCELLANEOUS MATERIALS

- A. Metal Covers, Grates, Frames and Accessories:
 1. Conform to Section 206 - Miscellaneous Metal Items of the Standard Specifications for Public Works Construction.
 2. Hot-dip galvanize steel parts after fabrication in accordance with Section 210 - Paint and Protective Coatings of the Standard Specifications for Public Works Construction.
 3. Grates and Frames:
 - a. Vandal-proof design and construction.
 - b. ADA compliant, in conformance to CBC 11B-302.3.
 - c. Rated for vehicular traffic on areas intended for use by motor vehicles.
 - d. Hot-dip galvanized.
- B. Concrete, Mortar and Related Materials: Conform to Section 32 1313 - Site Concrete Work.
- C. Manhole Brick Mortar, Grout, and Plaster: Conform to Standard Specifications for Public Works Construction, Section 202 - Masonry Materials.
- D. Underground Concrete Structures: Shall be precast and rated for H-20 traffic loading and applicable soil loads. The materials and structural design of the devices shall be per ASTM C857 and ASTM C858.

2.07 NAMEPLATES

- A. stainless steel or aluminium nameplate permanently fastened to BMP showing the following information:
 1. BMP ID number and BMP type.
 2. Next service day followed by a 1-inch by 4-inch long blank space.
 3. Manufacturer name, model number, telephone number and stock ID number.
 4. Installation or production date.
 5. 1-inch by 4-inch blank space for OWNER's use.

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. CONTRACTOR shall arrange for a preconstruction meeting with the manufacturer's representative to review the basic principles for proper installation of Underground BMP type products prior to any installation.
- B. Underground Concrete modules shall be installed in accordance with manufacturer's instructions and the current ASTM C891 procedures.

3.02 EXCAVATION, BACKFILLING AND COMPACTING

- A. Conform to the requirements of Section 31 2313 - Excavation and Fill or Section 31 2323 - Excavation and Fill for Utilities, as required.

3.03 INSTALLATION OF PIPE

- A. Conform to Section 306 - Underground Conduit Construction of the Standard Specifications for Public Works Construction.
- B. Non-ferrous drainpipe installed with less than 12 inches of cover to finish grade shall be provided with a 4-inch thick concrete pipe encasement.

3.04 DRAINAGE APPURTENANCES

- A. Catch basins, junction chambers, manholes, box culverts, outlet chambers and other drainage structures: Construct as indicated on Drawings and as specified in Section 32 1313 - Site Concrete Work, and in compliance with the Standard Specifications for Public Works Construction, Section 303 - Concrete and Masonry Construction.
- B. Ensure that Post Construction BMP have a visible identifying manufacturer tag with product identification, manufacturer contact information, date of last service and date of next service due.
- C. Provide storm drain stencil per City or County requirements as applicable.

3.05 ABANDONED DRAINAGE LINES AND STRUCTURES

- A. Cap or plug existing drain lines that are cut and abandoned and remove existing drainage structures that are abandoned.

3.06 CLOSED-CIRCUIT TELEVISION INSPECTION

- A. Coordinate with OAR time and date of inspection. Project Inspector shall be present during the CCTV inspection.
- B. Clean laterals by hydraulic jet.
- C. Perform internal closed-circuit television inspection of lateral from the building to the public mainline. Record drain line in its entirety with no breaks or interruptions. Move camera at a speed no greater than 30 feet per minute, stopping for a minimum of ten seconds to record pipe connections, defects, and points of interest.
- D. Maintain technical quality, sharp focus and distortion free picture. Pan, tilt, and rotate as necessary to best view and evaluate connections, defects and points of interest.
- E. Minimum Requirements for Closed-circuit Television Equipment:
 - 1. Television camera specially designed for pipe inspections, and operative in 100 percent humidity conditions.
 - 2. Camera and television monitor capable of producing minimum 470H-line resolution color video picture.
 - 3. Camera capable to inspect lines as small as three inches up to 70 feet from

storm drain mainline.

4. Camera lighting shall be suitable to allow clear picture of inner wall at least ten feet in front.

F. Defective Work:

1. New Lines: Defective Work found shall be repaired at CONTRACTOR's expense. Perform a new closed-circuit television inspection at no cost to OWNER.
2. Existing Laterals:
 - a. If roots, sludge, or sediment material or other defect not related to the Work of this project impedes inspection, withdraw camera, restart inspection from opposite end and notify OAR of defects found.
 - b. If obstruction or stoppage was caused by Work related to this project, remove obstruction at no cost to OWNER. Perform a new closed-circuit television inspection at CONTRACTOR's expense.

3.07 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.
- B. Maintain Post Construction BMP after installation and keep a maintenance log to be turned over to OAR at Substantial Completion.

3.08 PROTECTION

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

END OF SECTION