



SOUTH SAN FRANCISCO USD

SKYLINE ELEMENTARY SCHOOL

DSA: 01-122566
SKYLINE ELEMENTARY SCHOOL
HVAC REPLACEMENT PROJECT FOR
BUILDINGS A, B, C, D AND E

TECHNICAL SPECIFICATIONS

DIVISION OF THE STATE ARCHITECT
SPECIFICATIONS SUBMITTAL

September, 2025

HY HIBSER YAMAUCHI ARCHITECTS

OAKLAND

DAVIS

PROJECT MANUAL

For

SKYLINE ELEMENTARY SCHOOL HVAC REPLACEMENT PROJECT

55 Christen Avenue
Daly City, CA 94015

100% CD Set Submittal

Date: 5/16/2025

Hibser Yamauchi Architects, Inc.
300 27th St
Oakland, CA 94612
Tel: (510)446-2222

SECTION 00 01 03
Project Directory

OWNER:

SOUTH SAN FRANCISCO UNIFIED SCHOOL
DISTRICT
398 B St
South San Francisco, CA 94080
Office: (650) 877-8700
Contact: Wazi Chowdhury, Director of Facilities

ARCHITECTS:

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Oakland, CA 94612
Phone: (510) 446-2222
Contact: Craig Durand

MECHANICAL ENGINEER:

OPTIMUM ENERGY DESIGN
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Oakland, CA 94618
Office: (510) 837-9182
Contact: Andrea King

STRUCTURAL ENGINEER:

BASE DESIGN INC
582 Market St, Ste 1402
San Francisco, CA 94104
Office: (415) 466-2997
Contact: Katy Briggs

ELECTRICAL ENGINEER:

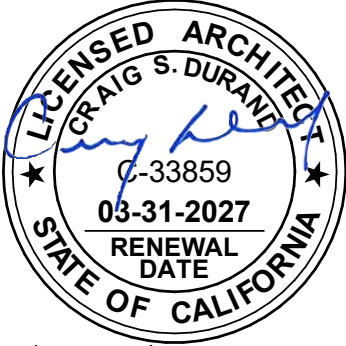
WKM ELECTRICAL
3397 Mt Diablo Blvd, Ste C
Lafayette, CA 94549
Office: (925) 385-0649
Contact: Tiffany Kane

END OF SECTION

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Seals Page

Skyline HVAC Replacement

55 Christen Ave
Daly City, CA 94015

 <p>Architectural</p>	 <p>Structural</p>	 <p>Mechanical</p>
 <p>Electrical</p>		<div>IDENTIFICATION STAMP DIV. OF THE STATE ARCHITECT APP: 01-122566 INC: REVIEWED FOR SS ☒ FLS ☒ ACS ☐ DATE: 3/10/2026</div>

Date: 2/13/26

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END OF SECTION

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END OF SECTION

SECTION 01 11 00

Summary of Work

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Work shown on Drawings.
- B. District-furnished products
- C. Contractor's use of site and premises.
- D. Work sequence.
- E. District occupancy.

1.2 WORK INCLUDED

- A. Work of this Contract comprises general construction including Replacement of the HVAC System at Buildings A, B, C, D, and E Skyline Elementary School located at 55 Christen Ave, South San Francisco, for South San Francisco Unified School District.

Note: The Project Manual and Construction Documents are intended to be complimentary; one does not supersede the other. If discrepancies or conflicts are found within the documents, notify the architect for clarifications.

- B. Construct the Work under a single Lump Sum Contract.

1.3 DISTRICT-FURNISHED PRODUCTS

- A. Items noted "OFCI" (District-Furnished, Contractor-Installed) will be furnished by District and installed by Contractor.
- B. Items noted "OFOI" (District-Furnished, District-Installed) will be furnished by District and installed by District.
- C. District's Responsibilities:
 - 1. Coordinate scheduling and delivery with Contractor.
 - 2. Arrange for and deliver District reviewed Shop Drawings, Product Data, and Samples to Contractor.
 - 3. Arrange and pay for product delivery to site.

4. On delivery, inspect products jointly with Contractor.
5. Submit claims for transportation damage and replace damaged, defective, or deficient items.
6. Arrange for manufacturer's warranties, inspections, and service.
7. Hiring the testing and inspection agency.
8. Hiring the Inspector of Record.

D. Contractor's Responsibilities:

1. Review District reviewed Shop Drawings, Product Data, and Samples.
2. Receive and unload products at site; inspect for completeness or damage, jointly with District.
3. Handle, store, install and finish products.
4. Repair or replace items damaged after receipt.

1.4 CONTRACTOR'S USE OF SITE AND PREMISES

A. Limit use of site and premises to allow:

1. District occupancy.

1.5 WORK SEQUENCE

- A. Construct Work in a manner to accommodate District's occupancy requirements during the construction period; coordinate construction schedule and operations with District and Architect.
- B. Should any existing conditions such as deterioration or noncomplying construction be discovered that is not covered by the DSA approved documents wherein the finished work will not comply with Title 24, California Code of Regulations, a construction change document, or a separate set of plans and specifications, detailing and specifying the required repair work shall be submitted to and approved by DSA before proceeding with the repair work.

1.6 DISTRICT OCCUPANCY

- A. The District will not occupy buildings A, B, C, D, E during the period of construction for installation of mechanical and associated electrical equipment.
- B. Cooperate with District to minimize conflict, and to facilitate District's operations.

C. Schedule Work to accommodate District occupancy.

PART 2 - PRODUCTS

Not used

PART 3 - EXECUTION

Not used

END OF SECTION

SECTION 01 33 00

Submittal Procedures

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Submittal procedures.
- B. Proposed products list.
- C. Shop Drawings.
- D. Product Data.
- E. Samples.
- F. Manufacturers' instructions.
- G. Manufacturers' certificates.
- H. Submittal schedule.

1.2 SUBMITTAL PROCEDURES

- A. Transmit each submittal in conformance with requirements of this Section.
- B. Sequentially number the transmittal forms. Resubmittals to have original number with an alphabetic suffix. Architect will not review more than 1 resubmittal for a specified product.
- C. Identify Project and Architect's project number, Contractor, subcontractor or supplier; pertinent Drawing sheet and detail number(s), and Specification Section number, as appropriate.
- D. Apply Contractor's stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents. Submittals without Contractor's stamp and signature will be returned without review. Incomplete submittals will be returned without review.
- E. Schedule submittals to expedite the Project, and deliver to Architect. Schedule shall include all items requiring color selection to be simultaneously submitted.
- F. Make submittals in groups containing associated and related items to make sure that information is available for checking each item when it is received.

1. Information to included, but not limited to:
 - a. Product Data Sheets
 - b. Safety Data Sheets
 - c. Fabrication Guidelines
 - d. Installation Guidelines
 - e. Product Warranties
 2. Submittals for all items requiring color selection must be received before any will be approved.
 3. Refer to associated and related individual specification sections for additional requirements.
- G. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.
- H. Make submittals far enough in advance of scheduled dates for installation to provide time for review and possible revisions and resubmission prior to approval and subsequent placement of orders.
- I. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit processing.
- J. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of the completed Work.
- K. Provide space for Contractor and Architect review stamps.
- L. Revise and resubmit submittals as required, identify all changes made since previous submittal.
- M. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.
- N. Submittals not requested will not be recognized or processed. Submittals not requested will be returned without review.

1.3 PROPOSED PRODUCTS LIST

- A. Within 10 calendar days after date of Notice to Proceed, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.4 SHOP DRAWINGS

- A. Submit one transparency and blue-line prints of each Shop Drawing in accordance with the submittal list. Review comments will be shown on the transparency and Contractor may make and distribute such copies as are required for his purposes. Provisions may be made for electronic transmittal at the [Owner][District]'s option.
- B. After review, distribute in accordance with procedures specified above and for Record Documents described in Section 01 77 00 Closeout Procedures.
- C. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.
- D. Do not use or allow others to use Shop Drawings which have been submitted and have been rejected.

1.5 PRODUCT DATA

- A. When specified in individual Specification Sections, submit copies of data for each product which Contractor requires. Provide for four copies to be retained by Architect.
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.
- C. After review, distribute in accordance with procedures specified above and provide copies for Record Documents described in Section 01 77 00 Closeout Procedures.

1.6 SAMPLES

- A. Submit Samples to illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate Sample submittals for interfacing Work.
- B. Where specific colors or patterns are not indicated, provide materials and products specified in the full range of color, texture and pattern for selection by Architect. Range shall include standard stocked color/texture/pattern, standard color/texture/pattern not stocked, but available from manufacturer, and special color/ texture/pattern available from manufacturer as advertised in Product Data and brochures. Unless otherwise indicated in individual Specification Sections,

Architect may select from any range at no additional cost to [Owner][District].

- C. Include identification on each Sample, with full Project information.
- D. Submit the number of Samples which Contractor requires, plus one which will be retained by Architect and one by the [Owner][District].
- E. Reviewed Samples which may be used in the Work are indicated in individual Specification Sections.

1.7 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual Specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.
- B. Identify conflicts between manufacturers' instructions and Contract Documents.

1.8 MANUFACTURER'S CERTIFICATES

- A. When specified in individual Specification Sections, submit manufacturers' certificate to Architect for review, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.

1.9 MOCK-UP

- A. Where indicated, provide mock-ups as required. Mock-ups shall be prepared per the Specifications and shall accurately and reasonably represent the quality of construction the Contractor will provide. If the mock-up or portions thereof do not adequately represent the quality of the Work specified, the Contractor shall modify the mock-up as needed.
- B. Once completed to the Architect's satisfaction, the mock-up shall serve as the standard of quality for the Work.
- C. All mock-ups, at the [Owner][District]'s option, shall remain the property of the [Owner][District]. If not required by the [Owner][District], Contractor shall remove and dispose of the mock-up.
- D. Where indicated, on-site mock-ups, if accepted, may be integrated into the

PART 2 - PRODUCTS

Not used

PART 3 - EXECUTION

3.1 SUBMITTAL SCHEDULE

SUBMITTAL LIST					
SPEC. SECTION	TITLE	MOCK-UP	**SAMPLE	CATALOG SHEET	*REPORT, SCHEDULE, OR SHOP DRAWING
01 73 29	Cutting and Patching		4		
01 33 00	Submittals Procedures		N/A	N/A	N/A
01 45 29	Testing Laboratory Services				2 + 0
01 62 00	Product Options and Substitutions				6 + 0
08 91 00	Metal Wall Louvers		4	6	4 + 1
05 43 00	Slotted Channel Framing			6	
09 29 00	Gypsum Board		4	6	
09 91 00	Painting		4	6	
23 30 00	Heating, Ventilating, and Air Conditioning		4	7	4 + 1
26 05 00	Basic Electrical Materials and Methods			6	4 + 1
26 05 26	Grounding and Bonding			6	4 + 1
26 05 33	Raceways and Boxes			6	
26 27 26	Wiring Devices		1	6	4 + 1
26 28 16	Enclosed Switches and Circuit Breakers			6	

* Indicates four (4) prints and one (1) transparency to be submitted.

** Samples are generally required for Architect's "color and material board" or for testing lab. To expedite approval, Contractor shall expedite the submittal of these items. Color board items will not be approved until all such items are received. Refer to Testing Laboratory Services, Section 01 45 29, Tests and Inspections List and other Sections for further requirements.

END OF SECTION

SECTION 01 33 23
Shop Drawings, Product Data, and Samples

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Definitions.
 - 2. Shop Drawings.
 - 3. Product Data.
 - 4. Samples.
- B. Related Sections
 - 1. Section 01 33 00 Submittal Procedures.

1.2 DEFINITIONS

- A. Manufactured: Standard units, usually mass-produced.
- B. Fabricated: Specifically assembled or made out of selected materials to meet design requirements.
- C. Shop Drawings: Documents establishing the actual detail of manufactured or fabricated items, indicating relation to adjoining work, identifying what work is performed at the project site, and amplifying design details of mechanical and electrical equipment in proper relation to physical spaces in the structure.
- D. Product Data: Manufacturer's standard drawings, descriptive literature, catalogs, brochures, performance and test data, wiring and control diagrams, installation/application instructions, other drawings and descriptive data pertaining to specified products.

1.3 SHOP DRAWINGS

- A. Submit under provisions of Section 01 33 00.
- B. Reproductions of Contract Drawings, Specifications, or portions thereof must not be used for shop drawing submittals.
- C. Present information in clear and thorough manner.
- D. Identify details by reference to Drawing and detail, schedule, or room numbers

shown and specified.

1.4 PRODUCT DATA

- A. Submit under provisions of Section 01 33 00.
- B. Clearly mark each copy to identify pertinent products and models.
 - 1. Modify to delete inapplicable information.
 - 2. Supplement standard information as required.
- C. Indicate performance characteristics and capacities.
- D. Show dimensions and clearances required.
- E. Show wiring, piping diagrams, and controls.

1.5 SAMPLES

- A. Submit under provisions of Section 01 33 00.
- B. Submit samples of sufficient size to illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- C. Submit samples of finishes from the full range of manufacturer's standard colors, custom colors when specified, textures and patterns for selection.
- D. Include identification on each sample with full project information.
- E. Reviewed samples which may be used in the Work are indicated in individual Sections.
 - 1. Only samples marked "No Exception Taken" may be incorporated into the Work.
 - 2. Samples that were intended to be incorporated into the Work will be returned, together with a written notice designating the sample with the appropriate review status and indicating errors discovered on review.
 - 3. Other samples will not be returned, but the same notice will be given, and such notice must be considered a return of the sample.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

SECTION 01 45 29
Testing Laboratory Services

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Selection and payment.
- B. Contractor submittals.
- C. Laboratory responsibilities.
- D. Laboratory reports.
- E. Limits on testing laboratory authority.
- F. Contractor responsibilities.
- G. Schedule of inspections and tests.

1.2 REFERENCES

- A. ASTM D3740-19 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- B. ASTM E329-20 - Standard Specification for Agencies Engaged in Construction Inspection, Test, or Special Inspection.
- C. CBC - California Building Code.
- D. Title 24, Part 2, of the California Code of Regulations.

1.3 OBSERVATIONS AND SUPERVISION

- A. The District and Architect or their appointed representatives will review the Work and the Contractor shall provide facilities and access to the Work at all times as required to facilitate this review. Administration by the Architect and any consulting structural engineer will be in accordance with applicable regulations, including, without limitation, CCR, Part 1, Title 24, Section 7-141.
- B. One or more Project Inspector(s) approved by the Authority Having Jurisdiction and employed by or in contract with the District, referred to hereinafter as the "Inspection", will observe the work in accordance with CCR, Part 1, Title 24, Sections 7-144(a)(b)(c), 7-145(a):

- 1. The Project Inspector shall have access to the tests wherever it is in

preparation or progress for ascertaining that the tests is in accordance with the Contract Documents and all applicable code sections. The Contractor shall provide facilities and access as required and shall provide assistance for sampling or measuring materials.

2. The Project Inspector will notify the District and Architect and call the attention of the Contractor to any observed failure of tests or material to conform to Contract Documents.
 3. The Project Inspector shall observe and monitor all testing and inspection activities required.
- C. The Contractor shall conform with all applicable laws as indicated in the Contract Documents, including, without limitation, to CCR, Part 1, Title 24, Section 4-343. The Contractor shall supervise and direct the Work and maintain a competent superintendent on the job who is authorized to act in all matters pertaining to the Work. The Contractor's superintendent shall also inspect all materials, as they arrive, for compliance with the Contract Documents. Contractor shall reject defective Work or materials immediately upon delivery or failure of the Work or material to comply with the Contract Documents. The Contractor shall submit verified reports as indicated in the Contract Documents, including, without limitation, the Specifications and as required by Part 1, Title 24, Section 7-151.

1.4 TESTS AND INSPECTIONS

- A. The Contractor shall be responsible for notifying the District and Project Inspector of all required tests and inspections. Contractor shall notify the District and Project Inspector forty-eight (48) hours in advance of performing any Work requiring testing or inspection.
- B. The Contractor shall provide access to Work to be tested and furnish incidental labor, equipment, and facilities to facilitate all inspections and tests.
- C. The District will pay for first inspections and tests required by the "CCRs", and other inspections or tests that the District and/or the Architect may direct to have made, including, but not limited to, the following principal items:
 1. Tests and observations for earthwork and paving.
 2. Tests for concrete mix designs, including tests of trial batches.
 3. Tests and inspections for structural steel capitalize Work.
 4. Field tests for framing lumber moisture content.
 5. Additional tests directed by the District that establish that materials and installation comply with the Contract Documents.

6. Test and observation of welding and expansion anchors.
 7. Factory observation of components and assembly of modular prefabrication structures and buildings.
- D. The District may, at its discretion, pay and back charge the Contractor for:
1. Retests or reinspections, if required, and tests or inspection required due to test failures Contractor error or lack of required identifications of material.
 2. Uncovering of Work in accordance with Contract Documents.
 3. Testing done on weekends, holidays, and overtime will be chargeable to the Contractor for the overtime portion.
 4. Testing done off site.
- E. Testing and inspection reports and certifications:
1. The Testing Agency shall send test and special inspection reports to each of the following entities listed below. Reports shall clearly state whether material met the requirements of the approved construction documents.
 - a. The District.
 - b. The Construction Manager, if any.
 - c. The Architect.
 - d. The Consulting Engineer, if any.
 - e. Other Engineers on the Project, as appropriate.
 - f. The Project Inspector
 - g. The Contractor.
 2. When the test or inspection is one required by the CCR, a copy of the report shall be provided to the Authority Having Jurisdiction.
 3. Reports are no longer sent to HCAI; HCAI field staff will review reports in the IOR's records as needed.

1.5 SELECTION AND PAYMENT

- A. District will employ and pay for services of an independent testing laboratory to perform specified inspection and testing as specified by District's testing laboratory.

- B. District's employment of testing laboratory shall in no way relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

1.6 [OWNER][DISTRICT]'S TESTING LABORATORY RESPONSIBILITIES

- A. Test samples of mixes submitted by Inspector.
- B. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
- C. Perform specified inspection, sampling, and testing of products in accordance with specified standards.
- D. Ascertain compliance of materials and mixes with requirements of Contract Documents.
- E. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
- F. Perform additional inspections and tests required by Architect.
- G. Attend preconstruction conferences and progress meetings when requested by Architect.

1.7 LABORATORY REPORTS

- A. After each inspection and test, District shall then submit one copy of laboratory report to Contractor. Laboratory shall submit copies of the report per the requirements of Section 01 33 00 Submittal Procedures. Reports of test results of materials and inspections found not to be in compliance with the requirements of the Contract Documents shall be forwarded immediately.
- B. Verification of Test Reports: Each testing agency shall submit in accordance with Section 01 33 00 Submittal Procedures, a verified report covering all of the tests which were required to be made by that agency during the progress of the project. Such report shall be furnished each time that Work on the Project is suspended, covering the tests up to that time and at the completion of the Project, covering all tests.

1.8 LIMITS ON TESTING LABORATORY AUTHORITY

- A. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
- B. Laboratory may not approve or accept any portion of the Work.
- C. Laboratory may not assume any duties of Contractor.

- D. Laboratory has no authority to stop the Work.

1.9 CONTRACTOR RESPONSIBILITIES

- A. Submit proposed items for testing as required herein and/or as defined in Section 01 45 00 Quality Control to Architect for review in accordance with applicable Specifications.
- B. Cooperate with laboratory personnel, and provide access to the Work and to manufacturer's facilities.
- C. Notify Architect, District's Representative, and testing laboratory 48 hours prior to expected time for operations requiring inspection and testing services:
 - 1. When tests or inspections cannot be performed after such notice, reimburse District for laboratory personnel and travel expenses incurred due to the Contractor's negligence.
 - 2. The Contractor shall notify the District's representative a sufficient time in advance of the manufacture of material to be supplied by him under the Contract Documents, which must by terms of the Contract be tested, in order that the District may arrange for the testing of same at the source of supply.
 - 3. Any material shipped by the Contractor from the source of supply prior to having satisfactorily passed such testing and inspection or prior to the receipt of notice from said representative that such testing and inspection will not be required shall not be incorporated in the job.
- D. Should additional inspections, sampling and testing be required by the testing laboratory when initial tests indicate Contractor's Work and/or materials does not comply with Contract Documents, services shall be paid for by the Owner and may be backcharged to the Contractor.

1.10 SCHEDULE OF INSPECTIONS AND TESTS BY [OWNER][DISTRICT]'S TESTING LABORATORY

- A. The testing agency shall perform tests and inspections per the Authority Having Jurisdiction approved "Tests and Inspections" list as well as for the following in conformance with the (CBC) California Building Code (International Building Code with State of California Amendments), Title 24, Part 2, of the California Code of Regulations. [Furnish copies of Product Data and Test Reports as required. Furnish facilities for storage and curing of test samples.]:
 - 1. General Requirements (Chapter 17A):
 - a. Special Inspections - 1701A.

- b. Nondestructive Testing - 1704A.
 - c. Prefabricated Construction - 1709A.
- 2. Foundations (Chapter 18 and 33):
 - a. Compacted fill material 1804.6
 - b. Earth fill compaction - 3304.1.
- 3. Concrete (Chapter 19A):
 - a. Materials:
 - 1. Portland Cement Tests - 1903A.2.
 - 2. Concrete Aggregates - 1903A.5.
 - 3. Reinforcing Bars - 1903A.8, 1905A.1.5., 1908A.4
 - 4. Prestressing Steel & Anchorage – 1901A.3, 1910A.3, 1910A.5.
 - b. Concrete Quality:
 - 1. Proportions of Concrete - 1904A.1, 1904A.2, 1905A.1, 1905A.2, 1905A.3, 1905A.4, 1905A.5.
 - 2. Strength Tests of Concrete - 1908A.10
 - 3. Splitting Tensile Tests - 1905A.1.8
 - c. Concrete Inspection:
 - 1. Job Site Inspection - 1901A.6, 1903A.2.
 - 2. Reinforcing Bar Welding Inspection – 1903A.8
 - d. Anchors in Concrete:
 - 1. Drilled-In-Expansion Bolts or Epoxy-Type Anchors in Concrete – 1910A.3, 1911A.2.
- 4. Masonry (Chapter 21A):
 - a. Materials:
 - 1. Masonry Units - 2103A.1
 - 2. Portland Cement - 1910A.1.

- 3. Mortar & Grout Aggregates - 2103A.2, 2103A.3
 - 4. Reinforcing Bars - 2103A.4
- b. Masonry Quality:
 - 1. Portland Cement Tests - 1910A.1
 - 2. Mortar & Grout Tests - 2105A.3
 - 3. Masonry Prism Tests - 2105A.5
 - 4. Masonry Core Tests -2105A.4
 - 5. Masonry Unit Tests - 2105A.6
 - 6. Reinforcing Bar Tests – 1910A.2
- c. Masonry Inspection:
 - 1. Reinforced Masonry – 2103A.4
 - 2. Reinforcing Bar Welding Inspection – 2107A.3, 2108A.3
- 5. Structural Steel (Chapter 22A):
 - a. Materials:
 - 1. Structural Steel - 2203A.2, 2231A.1.
 - 2. Material Identification - 2203A.
 - b. Inspection and Tests of Structural Steel:
 - 1. Tests of H.S. Bolts, Nuts, Washers - 2204A.2, 2213A.1
 - 2. Tests of End Welded Studs - 2204A.1, 2213A.2
 - 3. Shop Fabrication Inspection - 2231A.4.
 - 4. High Strength Bolt Inspection - 1705A.2
 - 5. Welding Inspection - 1705A.2, 2204A.1
 - 6. Nelson Stud Welding - 2231A.3.
 - 7. Non-destructive Weld Testing - 1703A.
- 6. Wood (Chapter 23):
 - a. Materials:

1. Lumber and Plywood Grading – 2303.1.1
7. Roof Covering (Chapter 15):
 - a. Materials:
 1. Roof Tile Tests – 1505.1, 1506.3
8. Aluminum (Chapter 20):
 - a. Materials:
 1. Alloys – 2002.1.
 - b. Inspection.
 1. Welding – 2003
- B. Plumbing: Testing as specified in plumbing specifications including, but not limited to: sterilization, soil waste and vent, water piping, source of water, pressure, gas piping, downspouts and storm drains.
- C. Automatic Fire Sprinklers (where applicable): Testing as specified in plumbing specifications shall include, but not be limited to, hydrostatic pressure.
- D. Heating, Ventilating and Air Conditioning: Testing as specified in HVAC specifications shall include, but not be limited to: Ductwork tests, cooling tower tests, boiler tests, controls testing, piping tests, water and air systems, and test and balance of heating and air conditioning systems.
- E. Electrical: Testing as specified in Electrical Specifications, including, but not limited to, equipment testing, all electrical system operations, grounding system and checking insulation after cable is pulled.

1.11 PROJECT INSPECTOR'S ACCESS TO SITE

- A. A Project Inspector employed by the District in accordance with the requirement of State of California Code of Regulations Title 24, Part 1 will be assigned to the Work. His duties are specifically defined in Section 4 342 of Title 24, Part 1, and as indicated in the General Conditions.
- B. The District and the Construction Manager shall at all times have access for the purpose of inspection to all parts of the Work and to the shops wherein the Work is in preparation, and the Contractor shall at all times maintain proper facilities and provide safe access for such inspection.
- C. The Work of construction in all stages of progress shall be subject to the personal continuous observation of the Project Inspector. He shall have free access to any or all parts of the Work at any time. The Contractor shall furnish

the Project Inspector reasonable facilities for obtaining such information as may be necessary to keep him fully informed respecting the progress and manner of the Work and the character of the materials. Inspection of the Work shall not relieve the Contractor from any obligation to fulfill this Contract. The presence of a Project Inspector shall in no way change, mitigate or alleviate the responsibility of the Contractor.

- D. The Project Inspector is not authorized to change, revoke, alter, enlarge or decrease in any way any requirement of the Contract Documents, Drawings, Specifications or subsequent Change Orders.
- E. Whenever there is insufficient evidence of compliance with any of the provisions of Title 24, Part 2 of the California Code of Regulations or evidence that any material or construction does not conform to the requirements of Title 24, Part 2 of the California Code of Regulations, the Authority Having Jurisdiction may require tests as proof of compliance. Test methods shall be as specified herein or by other recognized and accepted test methods determined by the Authority Having Jurisdiction. All tests shall be performed by a testing laboratory accepted by the Authority Having Jurisdiction.

PART 2 - PRODUCTS

Not used

PART 3 - EXECUTION

Not used

END OF SECTION

SECTION 01 62 00 – Attachment A Notice of Request for Substitution

Substitution Request No.: _____

In accordance with the Conditions of the Contract and the provisions of Section 01 62 00, we hereby submit for consideration, this Notice of Request for Substitution for the following material, product, thing, or service:

Section	Paragraph	Specified Item
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Proposed Substitution: _____

The following supporting information is attached:

- ☐ Product Data including model numbers and descriptions.
- ☐ Certified test results attesting to equivalence.
- ☐ Product/material samples.
- ☐ Other: _____

Reason for proposed substitution:

- ☐ Specified or indicated item is unavailable.
- ☐ Significant cost reduction. Actual dollar savings to the Client if substitution is accepted: \$ _____
- ☐ Significant quality difference without cost change.
- ☐ Other: _____

Submitted and Certified By:

CONTRACTOR:

_____ Signature	_____ Date
_____ Name (Print)	_____ Title
_____ Firm Name	
_____ Address	_____ Phone
_____ City, State, Zip	_____ FAX

Received: _____
Date Architect of Record Representative

☐ Recommended:	_____	HY Architects, Inc.
☐ Rejected:	Date	Architect of Record
☐ Approved:	_____	
☐ Rejected:	Date	Client Project Manager

END OF SECTION

SECTION 01 73 29
Cutting and Patching

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements and limitations for cutting and patching of Work.

1.2 SUBMITTALS

- A. Submit written request in advance of cutting or alteration which affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather-exposed or moisture-resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight-exposed elements.
 - 5. Work of District or separate contractor.
- B. Include in request:
 - 1. Identification of Project.
 - 2. Location and description of affected Work.
 - 3. Necessity for cutting or alteration.
 - 4. Description of proposed Work, and Products to be used.
 - 5. Alternatives to cutting and patching.
 - 6. Effect on Work of District or separate contractor.
 - 7. Written permission of affected separate contractor.
 - 8. Date and time Work will be executed.

1.3 DESIGN CRITERIA

- A. Patching shall achieve security, strength, and weather protection, as applicable, and shall preserve continuity of existing fire ratings.
- B. Patching shall successfully duplicate undisturbed adjacent finishes, colors, textures, and profiles. Where there is dispute as to whether duplication is

successful or has been achieved to a reasonable degree, the Architect's judgment shall be final.

- C. Patching may be temporary if it is to be eventually replaced in a subsequent phase of Work.

1.4 CUTTING AND PATCHING

- A. Structural Work: Do not cut-and-patch structural Work in a manner resulting in a reduction of load carrying capacity or load/deflection ration. Submit proposal and request and obtain Engineer's approval before proceeding with cut-and-patch of new and/or existing structural Work.
- B. Operational/Safety Limitations: Do not cut-and-patch operational elements and safety components in a manner resulting in reduction of fire rating of any assembly, decreased performance, shortened useful life, or increased maintenance. The Contractor shall be responsible for the location of all existing utilities and coordinate all Work to avoid any interruption of service to adjacent properties and/or to other facility operations without proper notification.
- C. Visual/Quality Limitations: Do not cut-and-patch Work exposed to view, such as plaster, in a manner resulting in noticeable reduction of visual qualities and similar qualities, as judged by Architect. (Exterior and interior).
- D. Additional Requirements: In addition to Contract requirements, upon written instructions to Architect:
 - 1. Uncover work to provide for Architect's observation of covered Work.
 - 2. Remove samples of installed materials for testing.
- E. Limitation on Approvals: Architect's and/or Engineer's approval to proceed with cutting-and-patching does not waive right to later require removal/replacement of Work found to be cut and patched in an unsatisfactory manner, as judged by Architect and Engineer.

PAYMENT FOR INCURRED COSTS

The costs caused by ill-timed or defective Work, or Work not conforming to Contract Documents, including costs for additional service of Architect and Engineer, shall be paid by the party responsible for ill-timed, rejected or non-conforming Work.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Primary Products: Those required for original installation.
- B. Substitutions: Under provisions of Section 01 62 00.
- C. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
- D. If identical materials are unavailable or cannot be used, use materials that visually match the original.

PART 3 - EXECUTION

3.1 GENERAL

- A. Execute cutting, fitting, and patching to complete Work, and to:
 - 1. Fit the several parts together, to integrate with other Work.
 - 2. Uncover work to install ill-timed Work.
 - 3. Remove and replace defective and non-conforming Work.
 - 4. Remove samples of installed work for testing.
 - 5. Provide openings in elements of Work for penetrations of mechanical/electrical Work.

3.2 EXAMINATION

- A. Inspect existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching. Verify compatibility with and suitability of substrates and finishes to accept the new Work.
- B. After uncovering existing Work, inspect conditions affecting performance of Work.
- C. Do not cut and patch any piping, conduit, or equipment supports 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.
- D. 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 the Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

- E. Beginning of cutting or patching means acceptance of existing conditions.

3.3 PREPARATION

- A. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
- B. Provide protection from elements for areas which may be exposed by uncovering Work.
- 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 avoid interruption of services to occupied areas.

3.4 CUTTING AND PATCHING

- A. Execute cutting, fitting, and patching to complete Work.
- B. Fit products together, to integrate with other Work.
- C. Uncover work to install ill-timed Work.
- D. Remove and replace defective or non-conforming Work.
- E. Remove samples of installed Work for testing when requested.
- F. Provide openings in the Work for penetration of mechanical and electrical Work.
- G. Cut rigid materials using saw or drill. Pneumatic tools are not allowed without prior approval.

3.5 PERFORMANCE

- A. Execute Work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
- B. Employ skilled and experienced installer to perform cutting and patching.
- C. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- D. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load deflection ratio.
- E. Do not cut and patch operating elements and related components in a manner

that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

- F. Restore work with new products in accordance with requirements of Contract Documents.
- G. Fit Work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal all voids with fire-rated material, to full thickness of the penetrated element.
- I. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

END OF SECTION

SECTION 01 77 00 Closeout Procedures

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Closeout procedures.
- B. Final cleaning.
- C. Adjusting.
- D. Demonstration and Instructions.
- E. Project Record Documents.
- F. Operation and maintenance data.
- G. Warranties.
- H. Spare parts and maintenance materials.

1.2 CLOSEOUT PROCEDURES

- A. Request Architect's observation of rough-ins when walls and ceilings are still open for observation. Give Architect at least 48 hours notice. Architect will prepare punch list of unsatisfactory Work.
- B. When Work is substantially complete, submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is substantially complete in accordance with Contract Documents and ready for Architect's inspection. Certificate shall include evidence that equipment and systems have been tested in the presence of the Architect and manufacturer's representatives, where applicable. Substantial Completion shall be defined as 95% completion of all Work, including 100% completion of the following: air balance report and submittal, final testing of fire alarm by Local Fire Inspector/Consultant/District's Representative, mechanical utility commissioning with District's Representative, final electrical testing by IOR/testing laboratory, all finishes, painting (except touch-up), cleaning of Project area (including window washing).
- C. Provide submittals to Architect that are required by governing or other authorities.
- D. Punch List:
 - 1. Contractor shall correct all punch list items within twenty days of delivery of

the punch list, but no later than the final completion date.

2. Prior to submission of its request for final payment, Contractor shall certify that a completed set of Project Record Documents has been submitted to the Architect for final review.

E. Final Inspection:

1. Within seven days after notice by the Contractor of completion of punch list work, the Architect will conduct the final inspection with the District and the Contractor.
2. Items found not resolved may be cause for back charge of additional time for Architect to re-visit the site for final verification.

- F. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

- G. Submit affidavit of payment of debts and claims, AIA Document G706.

- H. Submit affidavit of release of liens, AIA Document G706A.

- I. Submit consent of Contractor's surety to final payment, AIA Document G707.

1.3 REINSPECTION FEES

- A. Architect (and his consultants, if required) will perform 1 observation of rough-ins, and 1 observation of Work that is substantially complete. When punch list items have been completed, Architect will observe to verify.
- B. Should the Architect and his Consultants have to perform re-inspections and punch list due to failure of the Work to comply with the status of completion claimed by the Contractor; District will deduct the amount of compensation for such re-inspections and punch lists from the final payment to the Contractor.

1.4 FINAL ADJUSTMENT OF ACCOUNTS

- A. Submit a final statement of accounting to the Architect.
- B. Statement shall reflect all adjustments to the Contract Sum:
 1. The original Contract Sum.
 2. Additions and Deductions Resulting From:
 - a. Previous Change Orders.
 - b. Deductions for uncorrected Work.

- c. Penalties and bonuses.
 - d. Deductions for liquidated damages.
 - e. Deductions for re-inspection payment.
 - f. Other adjustments.
- 3. Total Contract Sum, as adjusted.
 - 4. Previous payments.
 - 5. Sum Remaining Due: Architect will prepare a final Change Order, reflecting approved adjustments to the Contract Sum, which were not previously made by Change Order.

1.5 FINAL APPLICATION FOR PAYMENT

- A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the General Conditions.

1.6 RELATED REQUIREMENTS

- A. As a condition precedent to final acceptance of the Project, the Contractor shall provide spare/loose parts, maintenance materials and operation manuals as required by various Sections of the Specifications.
 - 1. Parts and materials shall be packaged so as to preclude damage in normal handling and storage.
 - 2. Packages shall be labeled with full description of contents and Project name.
 - 3. Place packaged parts and materials at location directed by District's representative.
 - 4. Maintenance and Operation Manuals: Provide permanent quality manual of maintenance and operation for all materials requiring operation or for which manufacturer, supplier, or installer recommend maintenance (i.e., floor coverings, roofing, operating mechanisms, electrical devices, paint, etc.). Manuals shall contain manufacturer's instructions and recommendations for proper operation and maintenance. Where applicable, include parts list, sources of parts, service and program for frequency of maintenance. Five sets required, bound in 3-ring binders, shall be provided by Contractor.
 - 5. Prior to turning over any operations manuals or spare/loose parts, accompanied by a CD-ROM, Contractor shall submit for approval and,

upon approval, shall maintain a master log of required manuals and parts, including description, Specification reference, responsibility designation, anticipated and actual delivery dates, delivery acknowledgement, etc.

- B. The General Conditions cover the Contractor's responsibility to remedy defects due to faulty workmanship and materials which appear within one year from the date of recording of the Notice of Acceptance.
- C. Special warranties are required by various Sections of the Specifications. Assemble written warranties, label and submit to the Architect for review and transmittal to the District.
 - 1. Equipment warranties shall be written in the manufacturer's standard form and shall be countersigned by the subcontractor or supplier and the Contractor.
 - 2. All other warranties shall be written on the subcontractor's or supplier's letterhead and shall be countersigned by the Contractor.
 - 3. Bind warranties and bonds in heavy-duty five sets of commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper. 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. The CD-ROM shall be included in the binder side pocket.
 - 4. When operating and maintenance manuals are required for warranted construction, provide additional copies of each warranty, as necessary, for inclusion in each required manual.

1.7 FINAL CLEANING

- A. Execute final cleaning prior to final inspection. Work includes sweeping, brushing, and other general cleaning of completed Work and removal of debris, surplus material, and tools not in active use, scaffolding and other equipment no longer needed.
- B. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures to a sanitary condition.
- D. Replace filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.

- G. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.8 FIRE PROTECTION

- A. Store volatile/hazardous waste in covered metal containers and remove from premises daily in a manner which complies with all ordinances, regulations, and laws regarding hazardous materials.

1.9 POLLUTION CONTROL

- A. Conduct clean-up and disposal operations to comply with codes, ordinances regulations, and anti-pollution laws.

1.10 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

1.11 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to District's personnel two weeks prior to date of final inspection.
- B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- C. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with District's personnel in detail to explain all aspects of operation and maintenance.
- D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed-upon times, at equipment location.
- E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.12 PROJECT RECORD DOCUMENTS

- A. Maintain on site, one set of the following Record Documents; record actual revisions to the Work in contrasting color.
 - 1. Contract Drawings.
 - 2. Specifications.

3. Addenda.
 4. Change Orders and other Modifications to the Contract.
 5. Reviewed Shop Drawings, Product Data, and Samples.
- B. Store Record Documents separate from documents used for construction, in a clean, dry environment and maintain sets in good order.
- C. Record information concurrent with construction progress.
- D. Specifications: Legibly mark and record at each Section in contrasting color ink, description of actual products installed, including the following:
1. Manufacturer's name and product model and number.
 2. Changes made by Addenda and Modifications.
- E. Contract Drawings and Shop Drawings: Legibly mark each item in contrasting color ink to record actual construction including:
1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 3. Field changes of dimension and detail, identified by RFI or Change Order.
 4. Details not on original Contract Drawings.
- F. After final inspection is requested, Contractor shall submit Record Documents to the Architect for review. Contractor shall make such revisions or corrections as may be necessary for the Drawings and Specifications to be a true, complete, and accurate record of the Work.
1. Accompany submittal with transmittal in duplicate, containing:
 - a. Date.
 - b. Project title and number.
 - c. Contractor's name and address.
 - d. Title and number of each Record Document.
 - e. Signature of Contractor or his authorized representative.
- G. Submit documents to Architect for final Application for Payment. Inadequate or incomplete Record Documents may be used as cause for withholding payment.

1.13 RECORD DRAWINGS

- A. Architect will provide Contractor with one set of reproducible sepia plans of the original Contract Drawings.
- B. Contractor shall maintain one set of marked-up prints kept at each job-site and updated each month, or as otherwise agreed, shall transfer changes and information indicated on the marked-up blue line prints to the reproducible drawings. Contractor shall submit to the Architect one set of blue line prints showing all changes incorporated into the Work since the preceding monthly submittal. The Record Drawings shall be available at the Project Site.
- C. Label and date each Record Drawing "RECORD DOCUMENT" in legibly printed letters.
- D. Deviations in construction, especially pipe and conduit locations and deviations caused by Change Orders, Field Clarifications, Requests for Clarification and Addenda shall be accurately and legibly recorded.
- E. Locations and changes shall be done in a neat, legible manner and, where applicable, indicated by drawing a "cloud" around the changed or addition information.

1.14 RECORD DRAWING INFORMATION

- A. Record the following information:
 - 1. Locations of Work buried under or outside each building, such as plumbing and electrical lines and conduits.
 - 2. Actual numbering of each electrical circuit.
 - 3. Locations of significant Work concealed inside each building whose general locations are changed from those shown on the Contract.
 - 4. Locations of all items, not necessarily concealed, which vary from the Contract Documents.
 - 5. Installed location of all cathodic protection anodes.
 - 6. Deviations from the sizes, locations, and other features of installations shown in the Contract Documents.
 - 7. Locations of underground Work, points of connection with existing utilities, changes in direction, valves, manholes, catch basins, capped stub-outs, invert elevations, etc.
 - 8. Sufficient information to locate Work concealed in each building with

reasonable ease and accuracy. In some instances, this may be by dimension, in others; it may be in relation to the spaces in the building near which it was installed.

1.15 OPERATION AND MAINTENANCE DATA

- A. Provide Data For:
 - 1. Fire alarm system.
 - 2. Mechanical equipment and controls.
 - 3. Energy management system.
 - 4. Electrical system.
 - 5. Security and communication systems.
- B. Submit prior to final inspection, bound in 8-1/2" x 11" text pages, three-ring, D-size binders with durable vinyl covers plus one CD-ROM for all equipment in the above categories.
- C. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of Project, and subject matter of binder when multiple binders are required.
- D. Internally subdivide the binder contents using permanent page dividers with laminated plastic tabs, logically organized in Parts as described below.
- E. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, engineers, Contractor, subcontractors, and major equipment suppliers.
- F. Part 2: Operation and maintenance instructions, arranged by Specification Section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:
 - 1. Significant design criteria.
 - 2. List of equipment.
 - 3. Parts list for each component.
 - 4. Operating instructions.
 - 5. Maintenance instructions for equipment and systems.
 - 6. Maintenance instructions for finishes, including recommended cleaning methods and materials.

G. Part 3: Project documents and certificates, including the following:

1. Shop Drawings and Product Data.
2. Air and water balance reports.
3. Certificates.
4. Photocopies of warranties.

1.16 WARRANTIES

- A. Provide duplicate notarized copies.
- B. Execute and assemble documents from subcontractors, suppliers, and manufacturers, including items furnished by District.
- C. Provide Table of Contents and assemble in binder with durable plastic cover.
- D. Submit prior to final Application for Payment.
- E. For items of Work delayed beyond date of Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.
- F. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of warranty on the Work that incorporates the products.
- G. Manufacturer's letter of intent to furnish products and services beyond the warranty period where indicated.
- H. Manufacturer's disclaimer and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.
- I. When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.
- J. When Work covered by warranty has failed and has been corrected, reinstate warranty by written endorsement. Reinstated warranty shall be equal to original warranty with equitable adjustment for depreciation.
- K. Upon determination that Work covered by warranty has failed, replace or repair Work to an acceptable condition complying with requirements of the Contract Documents.

1.17 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual Specification Sections.
- B. Deliver to Project Site and place in location as directed.
- C. Obtain signed receipt for delivery of materials and submit prior to application for final payment.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

- A. Use only those cleaning materials which will not create disruptive fumes or hazards to health or property and which will not damage surfaces.
- B. Use only cleaning materials and methods recommended by manufacturer of surface to be cleaned and by cleaning agent material manufacturer. Repair or replace surfaces damaged due to use of improper cleaners and techniques.

PART 3 - EXECUTION

3.1 CLEAN-UP DURING CONSTRUCTION

- A. Execute daily cleaning to keep Work, site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris resulting from construction operations.
- B. Provide on-site containers for the collection of waste materials, debris, and rubbish.
- C. Remove waste materials, debris and rubbish from the site daily or dispose of in approved container on-site.

3.2 DUST CONTROL

- A. Clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
- B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces
- C. Vacuum clean interior building areas when ready to receive finish painting and continue vacuum cleaning on an as-needed basis until building is ready for

acceptance and occupancy.

- D. Lower waste materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.
- E. Conform to City, County, and State dust control regulations.

3.3 GENERAL CLEANING REQUIREMENTS

- A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed interior and exterior surfaces.
- B. Wash and shine glazing mirrors.
- C. Polish glossy surfaces to a clear shine.
- D. Clean glass; remove labels, fingerprints, grease, dirt stains, spots, marks, and other foreign materials from exposed exterior and interior surfaces.
- E. Clean hardware, plumbing fixtures, and chrome and storefront systems; remove paint spots, asphalt and smears from surfaces; clean fixtures and wash concrete and tile floors.
- F. Comply with all special cleaning, waxing and finishing instructions contained in Contract Documents.
- G. Restore existing improvements, inside or outside property, which were disturbed, damaged or destroyed as a result of Work under this Contract.
- H. Restore and replace damaged material conforming to original colors, textures, lines, grades, shapes and kind, except as otherwise required. Labor, material and methods used in restoring improvements shall conform to directions obtained from Architect before commencing Work.

3.4 FINAL CLEANING

- A. Use experienced workmen and professional cleaners for final cleaning.
- B. Legally dispose of waste materials, debris and rubbish off the site.
- C. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials, from exposed and semi-exposed surfaces.
- D. Repair, patch and touch-up marred surfaces to specified finish, to match adjacent surfaces.
- E. Vacuum clean all interior spaces including inside cabinets. Broom clean paved surfaces. Rake clean other surfaces of grounds.

- F. Broom and water clean paved surfaces and walks. Rake clean other surfaces and grounds.
- G. Maintain cleaning until building or portion thereof, is accepted and occupied by District.
- H. At completion of construction and just prior to final acceptance or occupancy, conduct final inspection exposed interior and exterior surfaces.

3.5 VENTILATING SYSTEM CLEANING

- A. Clean permanent filters and replace disposable filters if units were operated during construction.
- B. Clean ducts, blowers and coils if units were operated during construction.

END OF SECTION

SECTION 01 78 36

Warranties

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for Project warranties and guarantees.

1.2 DEFINITIONS

- A. Standard Product Warranties: Preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the District.
- B. Special Warranties: 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 District.

1.3 GENERAL REQUIREMENTS

- A. Guarantees between Contractor and manufacturers and between Contractor and suppliers shall not affect warranties between Contractor and District.
- B. Contractor shall not be held responsible for defects due to misuse, negligence, willful damage, improper maintenance, or accident caused by others nor shall he be responsible for defective parts whose replacement is necessitated by failure of District's maintenance forces properly to clean and service them, provided that Contractor has furnished complete operating and maintenance instructions to District.
- C. In addition to other requirements specified:
 - 1. Compile specified service and maintenance contracts.
 - 2. Coexecute submittals when so specified.
 - 3. Review submittals to verify compliance with Contract Documents.
 - 4. Submit to Architect for review and transmittal to District.
- D. In case of items remaining uncompleted after date of Substantial Completion, the warranty period shall run from the date of acceptance of such items.
- E. Special warranties applicable to definite parts of the Work and as specifically stipulated in the separate Sections of the Specifications or other Contract Documents shall be subject to the terms of this Section during the first year of the

life of such warranty.

- F. If repairs or changes are required in connection with the warranted Work within any warranty period, the Contractor shall, promptly upon receipt of notice from the District or Architect and without expense to the District, comply with the following:
 - 1. Place in satisfactory condition, in every particular, all of such warranted Work, and correct all defects therein.
 - 2. Make good damage to the buildings or site which is the result of the cause for said repairs and changes.
 - 3. Make good any Work, including the equipment and contents of said buildings or site, disturbed in fulfilling any such warranty.
- G. The District may, at its sole discretion, after the Contractor has received seven days' written notice, repair or cause to be repaired special equipment which has been furnished and installed and which may be damaged and the repair of which is included in the provision of any warranty.
 - 1. However, where special equipment is involved which, because of its inherent nature, may suffer further damage or cause loss to the District owing to the 7-day delay, the District may, after notice, cause such equipment to be repaired.
 - 2. The cost of such repairs shall be recoverable from the Contractor to the amount of the cost to the District for the completion of such repairs and the reconditioning of the equipment to its exact state prior to damage.
- H. If repairs or changes are required in connection with warranted Work within any warranty period and notice thereof is given within such period, the warranty shall continue as to Work requiring repair or change until the things herein required to be done are completed, and the termination of the warranty period shall not apply thereto.
- I. In case of Work performed by subcontractors and where special warranties are required, warranties addressed to and in favor of the District shall be secured from said subcontractors.
- J. No provision in the Contract Documents nor in any special or general warranty shall be held to limit, as to time or scope of liability, the Contractor's liability for defects or the liability of his sureties to less than the legal limit of liability under laws having jurisdiction.
- K. The delivery of any warranties shall not relieve the Contractor from any obligation assumed under any other provision of the Contract Documents.

- L. The obligation of the Contractor under this Section shall survive the termination of the Contract.

1.4 FORM OF WARRANTY

- A. Submit the following written warranty for special warranties and warranties in excess of one year, typed on subcontractor's letterhead, when required by a Specification Section:

WRITTEN WARRANTY FOR

We hereby warrant that _____ which we have provided in _____ has been completed in accordance with Specification Section _____ and Contract Documents requirements.

We agree to repair or replace any or all of our Work, together with any other adjacent Work which may be displaced or damaged by so doing, which may prove to be either patently defective in its workmanship or materials within the period of time prescribed by law or latently defective in its workmanship or materials within a period of ____ year(s) from date established in the Certificate of Substantial Completion of above-named structure, ordinary wear and tear and unusual abuse or neglect excepted.

We also agree to repair any and all damages resulting from such defects.

In the event of our failure to comply with above-mentioned conditions within a reasonable time but in no case longer than 7 calendar days after being notified in writing by the District, we collectively and separately do hereby authorize the District to have said defective Work and damages repaired or replaced and made good at our expense and will honor and pay the costs and charges therefore upon demand.

SIGNED _____
(Subcontractor's name, address, license number, and date of signing)

COUNTERSIGNED _____
(Contractor's name, address, license number, and date of signing)

1.5 SUBMITTAL REQUIREMENTS

- A. Assemble warranties, bonds, and service and maintenance contracts executed by each of the respective manufacturers, suppliers, and subcontractors.
- B. Number of Original Signed Copies Required: Two each.
- C. Contents:
 - 1. Neatly typed, in orderly sequence.
 - 2. Provide complete information for each item including:
 - a. Product or Work item.
 - b. Firm name with name of principal, address, and telephone number.
 - c. Scope.
 - d. Date of beginning of warranty, bond, or service and maintenance contract.
 - e. Duration of warranty, bond, or service and maintenance contract.
 - 3. Provide the following information for District's personnel:
 - a. Proper procedure in case of failure.
 - b. Circumstances which might affect the validity of warranty or bond.
 - 4. Contractor's name, name of responsible principal, address, and telephone number.

1.6 FORM OF SUBMITTAL

- A. Prepare in duplicate packets.
- B. Format:
 - 1. Size: 8-1/2" x 11" sheets punched for three-ring binder. Fold larger sheets to fit into binders.
 - 2. Cover: Identify each packet with typed or printed title, "WARRANTIES" and list the title of Project and name of Contractor.
- C. Binders: Commercial quality, three ring, "View" type, with durable and cleanable plastic covers.

1.7 TIME OF SUBMITTALS

- A. Within 30 days after date of Substantial Completion, prior to final request for payment.
- B. For items of Work, where acceptance is delayed materially beyond the date of Substantial Completion, provide updated submittal within 30 days after acceptance listing the date of acceptance as the start of the warranty period.

1.8 SUBMITTALS REQUIRED

- A. Submit special warranties, bonds, and service and maintenance contracts specified in the individual Sections.

PART 2 - PRODUCTS

Not used

PART 3 - EXECUTION

Not used

END OF SECTION

SECTION 01 87 00
Material and Equipment

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Products.
- B. District-furnished items.
- C. Transportation and handling.
- D. Storage and protection.
- E. Damage and restoration.

1.2 PRODUCTS

- A. Products: New material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components if designated for reuse.
- B. Provide interchangeable components of the same manufacturer, for similar components.
- C. Provide products that comply with the Contract Documents that are undamaged and are unused at the time of installation.
- D. Provide products complete with all accessories, trim, finish, safety guards and other devices and detail needed for a complete installation and for the intended use and effect.
- E. Where products are specified by name or by manufacturer provide the product or manufacturer specified. No substitutions will be permitted unless made under the provisions of Section 01 62 00 Product Options and Substitutions.
- F. Where Specifications only describe a product or assembly by listing exact characteristics required, provide a product or assembly that provides the characteristics.
- G. Where Specifications only require compliance with performance requirements, provide products that comply with those requirements.
- H. Where the Specifications only require compliance with an imposed code, standard or regulation, provide a product that complies with the standards, codes or regulations specified.

- I. Where Specifications require review and acceptance of a Sample, the Architect's decision will be final on whether a proposed product Sample is acceptable or not.
- J. Do not use materials and equipment removed from existing premises, unless as specifically directed.

1.3 TRANSPORTATION AND HANDLING

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Schedule delivery to minimize long-term storage at site to prevent overcrowding of construction spaces.
- C. Coordinate production and delivery of District-furnished items, where applicable.
- D. 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.
- E. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged. Notify District of any items received under District purchase, if applicable.
- F. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 STORAGE

- A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.
- B. For exterior storage of fabricated products, place on sloped supports, above ground.
- C. Provide off-site storage when site does not permit on-site storage.
- D. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.
- E. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- F. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- G. Arrange storage of products to permit access for inspection. Periodically inspect

to assure products are undamaged and are maintained under specified conditions.

- H. Prevent the discharge of pollutants to storm water from storage of materials on-site using best management practice techniques defined in Chapter 4 of the Construction Activity Handbook published by the Storm Water Quality Task Force.

1.5 PROTECTION

- A. Protect installed Work and provide special protection where specified in individual Specification Sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to minimize damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

1.6 DAMAGE AND RESTORATIONS

- A. Damage to existing or new Work, whether accidental or not, shall be restored or replaced as specified or directed by Architect.
- B. Restoration shall be equal to structural performance of original Work.
- C. Finish shall match appearance of existing adjacent Work.
- D. Work not properly restored or where not capable of being restored shall be removed and replaced.

PART 2 - PRODUCTS

Not used

PART 3 - EXECUTION

Not used

END OF SECTION

SECTION 06 10 00

Rough Carpentry

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. All lumber framing, rough hardware and blocking as indicated.

1.2 REFERENCES

- A. Published Specifications, standards, tests, or recommended methods of trade, industry, or governmental organizations apply to Work in this Section where cited by abbreviations noted below (latest editions apply).
 - 1. California Code of Regulations. Title 24, also known as California Building Code (CBC), with amendments.
 - 2. APA - American Plywood Association, "Product Guide: Performance Rated Panels".
 - 3. PS - United States Product Standard, PS-1 Series of "Construction and Industrial Plywood".
 - 4. UL - Underwriters' Laboratories, Inc.
 - 5. WCLIB - West Coast Lumber Inspection Bureau, "Standard Grading Rules No. 17".
 - 6. Pacific Lumber Inspection Bureau, "Western Lumber Grading Rules", Standard No. 17, 2018
 - 7. AWPA - American Wood Preservers Association Standards.
 - 8. ASTM - American Society of Testing and Materials.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings of all specially fabricated rough hardware.
- C. Certificates of compliance with standards specified.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Provide proper facilities for handling and storage of materials to prevent

damage to edges, ends, and surfaces.

- B. Keep materials dry. Where necessary, stack materials off ground on level flat forms, fully protected from weather.

1.5 JOB CONDITIONS

- A. Environmental Requirements: Maintain uniform moisture content of lumber at not more than 19% before, during, and after installation.
- B. Sequencing, Scheduling: Coordinate details with other Work supporting, adjoining or fastening to rough carpentry Work.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Rough Carpentry:

- 1. Sills on Concrete: Foundation grade Redwood or pressure-treated Douglas Fir.
 - 2. Lumber (Wood Framing): Meet requirements of following minimum grades.

<u>Item</u>	<u>Grade</u>
Studs	D.F. No. 2
Plates	D.F. No. 2
Beams	D.F. No. 1
Joists	D.F. No. 2
Posts	D.F. No. 1
Blocking	D.F. No. 2

- B. Plywood: Provide thickness, grade, and panel identification index shown on Drawings.
 - C. Rough Hardware: All exterior hardware shall be hot-dipped galvanized steel:
 - 1. Nails: Common wire, typical.
 - 2. Powder Driven Fasteners: Hilti Fastening Systems: Impex Tool Corporation; or approved equal. Tempered steel pins with special corrosion-resistant finish. Provide guide washers to accurately control penetration, maximum 3/4". Accomplish fastening by low-velocity piston-driven powder-actuated tool.
 - 3. Expansion Bolts: Red Head, Trubolt: "Wedge Type"; Hilti; "Kwik-Bolt III" or

approved equal. Reverse cone, self-wedging, expansion type, Tightening of nut or increased tension on bolt shank shall act to force wedges outward to create positive increased resistance to withdrawal.

4. Metal Timber Framing Connectors: Simpson Company or approved equal. Fabricate from hot-dipped galvanized steel. Connectors shall be at least 16 gauge material, 1/8" plate materials where welded, unless otherwise shown or specified, punched for nailing. Nails and nailing shall conform to the manufacturer's instructions, with a nail provided for each punched hole.
5. Miscellaneous Hardware: Provide all common screws, bolts, fastenings, washers and nuts required to complete rough carpentry Work.

2.2 TREATMENTS

- A. Fire-Retardant Treatment: Koppers Co., Inc.'s "FirePro, FlamePro", or approved equal.
- B. Preservative Treatment: Furnish in accordance with AWP.

2.3 FABRICATION

- A. Preparation:
 1. Verify measurements at job site.
 2. Verify details and dimensions of equipment and fixtures integral with finish carpentry for proper fit and accurate alignment.
 3. Coordinate details with other Work supporting, adjoining, or fastening to casework.
- B. Lumber:
 1. Air- or kiln-dry to maximum 19% moisture content prior to shipment. Stack and air-dry to maximum 15% in field prior to installation.
 2. Furnish surfaced four sides, S4S, unless otherwise noted.
 3. Size shall conform with rules of governing standard. Sizes shown are nominal unless otherwise noted.
- C. Wood Treatments:
 1. Preservative Treatment:
 - a. Treat lumber and plywood sheathing exposed to weather.
 - b. Lumber: Treat in accordance with AWP Book of Standards.

- c. Plywood: Treat in accordance with AWWPA Book of Standards.
- d. After treatment and prior to shipping, air- or kiln-dry lumber to maximum 19% moisture content. Air-dry in field to maximum 15% prior to installation.

2.4 QUALITY CONTROL

- A. Lumber shall bear grade-trademark or be accompanied by certificate of compliance of appropriate grading agency.
- B. Plywood shall bear APA grade-trademark.
- C. Air-dry all framing lumber to a maximum of 15% moisture content prior to installing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive rough carpentry Work and verify following:
 - 1. Completion of installation of building components to receive rough carpentry Work.
 - 2. That surfaces are satisfactory to receive Work.
 - 3. That spacing, direction, and details of supports are correct to accommodate installation of blocking, backing, stripping, furring and nailers.
 - 4. That all anchor bolts and holdown bolts are properly installed.

3.2 INSTALLATION

- A. Cutting: Perform all cutting, boring, and similar Work required.
- B. Studs, Joists, Beams, and Posts: Install all members true to line. No wood shingle shims are permitted. Place joists with crown up; maximum 1/4" crown permitted.
- C. Nail joints in accordance with applicable requirements of the CBC Table 2304.10.1 unless otherwise shown or specified. Predrill where nails tend to split wood.
- D. Bolt holes to be 1/16" oversize. Threads shall not bear on wood. Use standard malleable iron washers against wood. Carriage bolts require washers under the nut only.

- E. Provide blocking, grounds, nailers, stripping, and backing as shown and as required to secure other Work.
- F. Maintain 1/8" gap between all plywood panel edges.
- G. Do not utilize plywood sheets having a width smaller than 2'-0".
- H. Plywood flooring shall be field glued with adhesives meeting APA specification AFG-01 applied in accordance with the manufacturers' recommendations. Apply continuous line of glue on joists and in groove of tongue and groove panels.
- I. Where wood is cut, sawed, planed, bored or marred after preservative or fire-retardant treatment, apply two heavy brush coats of same material used in treatment.
- J. Nail heads shall be driven flush with plywood surface. Overdriven nails (nails which fracture the outer ply layer) shall be replaced one for one.
- K. Wood Screws or Lag Screws: Screws shall be screwed and not driven into place. Screw holes shall be predrilled to the same diameter and depth of shank. Holes for threaded portion shall be predrilled less than or equal to the diameter of the root of the thread. Provide standard cut washers under head of lag screws.
- L. Sills under bearing, exterior and shear walls shall be bedded on 1/2" minimum drypack or grout to obtain continuous bearing.

3.3 CLEANING AND ADJUSTING

- A. Remove damaged or otherwise disfigured portions and replace with new prior to the District's acceptance.
- B. Wash finished Work in strict accordance with product manufacturer's directions and ensure that washed surfaces do not differ from clean unwashed surfaces. Any difference will be considered unsatisfactory Work.

3.4 FIELD QUALITY CONTROL

- A. The District's Testing Agency shall:
 - 1. Inspect erected timber framing as required to establish conformity of Work with Drawings.
 - 2. Inspect all bolted connections.
 - 3. Inspect all timber connectors for compliance with CBC Chapter 23.
 - 4. Inspect roof diaphragm nailing for nail size, spacing and penetration at plywood panel edges, and special nailing at collector and drag members.

5. Inspect shear wall nailing for nail size, spacing and penetration at plywood panel edges, and nailing at holdown posts.

END OF SECTION

SECTION 07 01 52

Roofing Repair

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Provide all labor, equipment, and materials to maintain and protect the existing roof system. Install new turn up base flashings and roof penetrations while maintaining the existing system warranty at all new skylights, HVAC units, and roof penetrations.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: Installer (Roofer) shall be specialized in roof application with minimum 5 years experience. Installer shall be certified by the roofing system manufacturer as qualified to install manufacturer's roofing materials.
- B. Installer's Field Supervision: Installer shall maintain a full-time Supervisor/Foreman on job site during all phases of bituminous sheet roofing Work and at any time roofing Work is in progress, proper supervision of workers shall be maintained. A copy of the Specification shall be in the possession of the Supervisor/Foreman and on the roof at all times.
- C. It shall be the Contractor's responsibility to respond immediately to correction of roof leakage during construction. If the Contractor does not respond within 24 hours, the District has the right to hire a qualified contractor and backcharge the Contractor.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site with seals and labels intact, in manufacturer's original containers, dry and undamaged.
- B. Store and handle roofing materials in a dry, well-ventilated, weather-tight place to ensure no possibility of significant moisture exposure. Store rolls of felt and other sheet materials on pallets or other raised surface. Stand all roll materials on end. Cover roll goods with a canvas tarpaulin or other breathable material (polyethylene not acceptable).
- C. Do not leave unused rolled goods on the roof overnight or when roofing Work is not in progress unless protected from weather and other moisture sources.
- D. It is the responsibility of the Contractor to secure all material and equipment on the job site. If any material or equipment is stored on the roof, the Contractor shall make sure that the integrity of the deck is not compromised at any time. Damage to the deck caused by the Contractor will be the sole responsibility of

the Contractor and will be repaired or replaced at the Contractor's expense.

1.4 MANUFACTURER'S INSPECTIONS

- A. Manufacturer shall inspect Work in progress at least 3 days per week and shall inspect the completed Work.

1.5 PROJECT CONDITIONS

- A. Weather Condition Limitations: Do not apply materials during inclement weather or when there is a 40% or greater chance of precipitation.
- B. Materials shall be stored at room temperature until immediately prior to application when the ambient temperature is 40°F or below. Discontinue the application if the material cannot be stored at a temperature which permits even distribution during application.
- C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The Garland Company, local representative: Michael Grow (510) 524-1899.
- B. Or approved equal.
- C. Substitutions: Under provisions of Section 01 62 00.

2.2 DESCRIPTION

- A. Maintenance Roofing Work (Including But Not Limited To):
 - 1. Two ply hot asphalt applied modified turn up base flashing installation.
 - 2. Two ply modified pipe penetration strip in over lead jack.
- B. Base Flashing Installation:
 - 1. 1" insulation fill board shall be installed as needed at transition area between cut away field roofing and new base flashing. Provide an even transition area. Insulation height shall equal that of existing field roofing.
 - 2. All flashings shall be set in Type III hot steep asphalt. Modified reinforcing ply shall be one ply of smooth surface modified membrane covered by an additional layer of mineral surface modified bitumen membrane. Pipe

penetration flashings and turn-up base flashing corners shall be dressed with three courses of mastic/webbing and aluminized surfacing.

2.3 BITUMINOUS MATERIALS

- A. Asphalt Primer: V.O.C. compliant, ASTM D41, Garland "Garla-Prime" or approved equal.
- B. Roofing Asphalt: V.O.C. compliant, ASTM D312, Type III.

2.4 SHEET MATERIALS

- A. Fiberglass Webbing: Reinforcing fabric for turn up base flashing corners, The Garland Company, "GarMesh" or approved equal.
- B. Base Flashing Ply: The Garland Company, "Versiply 40 Technical Data" or approved equal.
- C. Modified Flashing Ply: The Garland Company, "Stressply FR Mineral" or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrate surfaces to receive roofing system and associated work and conditions under which roofing will be installed. Do not proceed with roofing until unsatisfactory conditions have been corrected in a manner acceptable to roof system manufacturer and installer.

3.2 FLASHING MEMBRANE INSTALLATION

- A. Install 1" insulation fill board as needed to provide an even transition area between cut away field roofing and new base flashing.
- B. Prepare all penetrations to be flashed and where shown on the Drawings with asphalt primer at the rate of one hundred square feet per gallon. Allow primer to dry tack-free.
- C. The two modified plies shall be adhered with the following:
 - 1. Hot steep asphalt. The smooth modified membrane and the modified cap membrane shall be used as the flashing and nailed off 8" on center at all vertical surfaces.
 - 2. At pipe penetrations, the smooth sheet shall be minimum 12" x 12" and

feather at least 6" beyond the roof cut transition area. The mineral surface flashing sheet shall extend a minimum 6" beyond the edge of the smooth sheet.

- D. The entire sheet of the base flashing and the flashing membrane shall be solidly adhered to the substrate.
- E. Seal all vertical laps of flashing membrane with a three-course application of mastic and fiberglass mesh. Aluminize with two coats of non-fiberglass aluminum paint.
- F. Aluminize all pipe penetration flashings with two coats of non-fiberglass aluminum paint.
- G. Roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices to be coordinated with the roofing Work is specified in other Sections.

3.3 FINAL INSPECTION

- A. At completion of roofing installation and associated Work, meet with installer, installer of associated Work, District, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system.
- B. Walk roof surface areas of the building, inspect perimeter building edges and flashing of roof penetrations, curbs, and other equipment. List all items requiring correction or completion and furnish copy of list to each party attending.
- C. The roofing system manufacturer reserves the right to request a thermographic scan of the roof during final inspection to determine if any damp or wet materials have been installed. The thermographic scan shall be provided by the roofing subcontractor at a negotiated price.
- D. If core cuts verify the presence of damp or wet materials, the roofing subcontractor shall be required to replace the damaged areas at his own expense.
- E. Repair or replace (as required) deteriorated or defective Work found at time of inspection to a condition free of damage and deterioration at time of Substantial Completion to comply with warranty requirements.
- F. The Contractor shall notify the District upon completion of corrections.
- G. Following the final inspection, acceptance will be made in writing by the material manufacturer.

END OF SECTION

SECTION 07 52 00
Modified Bituminous Sheet Roofing

PART 1 - GENERAL

1.1 REFERENCES

- A. Examine all Drawings and all other Sections of the Specifications for requirements affecting the work of this Section.
- B. ASTM C728 Standard Specification for Perlite Thermal Insulation Board
- C. ASTM C1289 Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
- D. ASTM D41 Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
- E. ASTM D312 Standard Specification for Asphalt Used in Roofing
- F. ASTM D3617 Standard Practice for Sampling and Analysis of Built-Up Roof Systems During Application
- G. ASTM D4586 Standard Specification for Asphalt Roof Cement, Asbestos-Free
- H. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
- I. CHPS - Coalition for High Performance Schools, Best Practices Manual Volume I thru VI: Criteria, 2009 edition. (If CHPS compliant)

1.2 SCOPE

- A. Furnish and install a new two-ply reinforced SBS modified membrane assembly as described herein.
- B. In the event these Specifications deviate from the manufacturer's current specifications, these specifications prevail, except where they conflict with the manufacturer's requirements for the specified guarantee. In the case where the specifications conflict with the manufacturer's requirements for the specified guarantee, the Contractor shall consult with the District.
- C. Install roofing materials by personnel who have been previously trained by the roof membrane manufacturer in the proper application of the roofing system specified in this Section of the Specifications.
- D. Coordination: Coordinate the work of this Section with other work of the Contract for Construction:

1. Verify the placement of wood blocking at all locations where nailing of the materials of this Section of the Specifications is required.
2. Related work such as roof drains, sheet metal edging/gravel stops, sheet metal flashing assemblies, gutters, and lead collars for pipes shall either be in place or shall be available for installation.

E. Definitions:

1. See ASTM D1079 - Standard Terminology Relating to Roofing and Waterproofing.
2. See The NRCA Roofing and Waterproofing Manual, 2017 edition; Glossary.
3. Roof System or Roofing System: A system of interacting roof components, generally consisting of a membrane or primary roof covering and roof insulation (not including the roof deck) designed to weatherproof a building's top surface.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. The following items of related work are specified and included in other Sections of the Specifications:
1. Blocking and nailers: Section 06 10 00 Rough Carpentry.
 2. Section 07 62 00 Sheet Metal Flashing and Trim.
 3. Section 09 91 00 Painting.
 4. Applicable Sections of the Specifications included in Division 15 and 16.

1.4 SYSTEM DESCRIPTION

- A. Roofing system description as follows:
1. Apply a base sheet.
 2. Apply rigid insulation board using hot asphalt.
 3. Apply one layer smooth surfaced modified bitumen interply using hot asphalt.
 4. Apply one layer granule surfaced modified bitumen finish ply using hot asphalt.
 5. Apply flashing plies.

- B. The completed roofing system shall arrest water migration from entering the building.
- C. Provide a Class "A" rated fire hazard assembly.
- D. Maximum sheet lengths and special fastening of the specified roof membrane may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot (1:24). The manufacturer shall provide the contractor acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes, and the roof membrane shall be installed in accordance with the manufacturer's recommendations with regard to supplemental nailing that may be required when roof slopes exceed 3/8 inch per foot.

1.5 QUALITY ASSURANCE

- A. Provide primary roofing products supplied by a single manufacturer which has been successfully producing the specified types of primary products for not less than ten (10) years. Provide secondary or accessory products which are acceptable to the manufacturer of the primary roofing products.
- B. Applicator qualifications: All roofing materials and sheet metal flashings shall be applied by roofing contractors with 10 years or more experience of successful application of the specified roofing systems in the local region. The roofing contractor shall be prepared to provide written evidence of his experience in the successful application of the materials specified herein. The written evidence shall include information related to the completion of five similar projects completed in the last five years, and shall include the name and telephone number of the District for whom the work was provided.
- C. The roofing contractor must be currently certified by the manufacturer to install the roofing system as specified herein. Furnish to the District written documentation that installer is certified to install roofing systems of the type specified in this Section of the Specifications. The roofing system shall be applied only by an approved contractor authorized by the manufacturer prior to solicitation.
- D. Contractor must present to the District a statement of current insurance coverage for any insurance required by the District. The insurance coverage(s) must remain in force for the duration of the project.
- E. Upon completion of roofing work, provide an inspection by a representative of the sheet roofing membrane manufacturer to assure installation is in accordance with the sheet roofing membrane manufacturer's requirements. The representative of the sheet roofing membrane manufacturer shall state in a letter to the District that he has reviewed the installation of the sheet roofing membrane and that the installation complies with the written specifications and

recommended installation details of the sheet roofing membrane manufacturer.

F. In addition to comply with other legal requirements, comply with:

1. Underwriters Laboratories Inc. (UL) Fire Hazard Classification.
2. Wind-uplift loadings: In accordance with the applicable building code and as noted herein:
 - a. Design uplift pressure: Calculate in accordance with procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems" before multiplication by a safety factor unless FM, ASCE 7, or the applicable building code require design uplift pressures greater than those noted in the referenced guide.
 - b. Provide a roofing system that is similar to systems that have been successfully tested by a qualified testing and inspection agency to resist uplift pressures as noted in the referenced guide, or if design uplift pressures are greater than those noted in the referenced guide in accordance with ASCE 7 or other reference standard required by FM or the applicable building code.
 - c. Factory Mutual Research Corporation (FMRC): Approved roof assembly FMRC Standard 4470, Class 1-90 Windstorm Classification.
 - d. ASCE 7, "Minimum Design Loads for Buildings and other Structures", latest edition. Design wind-uplift loads shall be determined as noted in ASCE 7 using the basic wind speed for the applicable geographic area.
 - e. In case of a conflict between FM standards and data sheets, and ASCE 7 use the highest loading for design purposes.

G. Reference specifications and standards:

Contractor's work shall comply with the following standards as applicable. Manufactured items are to be fabricated to these same standards.

The following standards (and publications) are applicable to the extent referenced in the text. The most recent of these standards is implied, unless otherwise stated.

1. The NRCA Roofing and Waterproofing Manual, fifth edition including applicable NRCA Construction Details; publication of the National Roofing Contractors Association. The referenced manual establishes minimum requirements. The drawings and specifications may modify guidelines included in the manual.
2. Applicable NRCA quality control guidelines.

3. The roofing system shall comply with applicable NRCA Construction Details. Unless otherwise specifically shown on the drawings, comply with the recommended details as illustrated and noted in the referenced NRCA manual.
 4. ASTM (American Society for Testing and Materials) latest edition of applicable standards including but not limited to the following:
 - a. ASTM C 728 - Standard Specification for Perlite Thermal Insulation Board.
 - b. ASTM D 41 - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
 - c. ASTM D 312 - Standard Specification for Asphalt used in Roofing.
 - d. ASTM D 4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free
 - e. ASTM - D 6162, D 6163, D 6164, and D 6298; Standard Specifications related to Styrene-Butadiene-Styrene (SBS) Modified Bituminous Sheets.
 - f. ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings.
 5. FM (Factory Mutual Engineering and Research) applicable standards and guidelines including but not limited to the following:
 - a. FM AS 4470 Class I Roof Covers.
 - b. FM P7825 - Approval Guide; Factory Mutual Engineering and Research, current edition.
 6. UL (Underwriters Laboratories) applicable standards and guidelines including but not limited to:
 - a. UL 790; Standard for Standard Test Methods for Fire Tests of Roof Covering.
 - b. UL RMSD; Roofing Materials and Systems Directory.
 7. Polyisocyanurate Insulation Manufacturers Association (PIMA): Applicable Technical Bulletins, Advisories, and other applicable publications.
- H. Product quality: Primary roofing materials shall be manufactured under a quality management system that is monitored regularly by a third party auditor. Certificates of analysis confirming the tested values of the actual materials being supplied for the project will be required prior to project close-out.

1.6 QUALITY CONTROL

- A. Quality control shall be performed by the contractor. The District may choose to implement a quality assurance program but implementation of a quality assurance program by the District shall not relieve the contractor of the requirement of providing a quality control program as described herein.
- B. Quality control program:
 - 1. A representative of the contractor or his designated subcontractor shall implement a quality control program to ensure that the roofing system is installed in accordance with the requirements noted on the drawings and in the specifications, and in accordance with reference standards. The representative shall be knowledgeable of the system and shall have the authority to bring roofing work back into compliance if non-complying work is observed.
 - 2. Minimum requirements:
 - a. Minimum standards are described in applicable NRCA publications. Unless otherwise accepted, the NRCA "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing" shall be incorporated into the quality control program and reports shall reference the applicable recommendations, criteria, and corrective action recommendations.
 - b. The requirements noted in the referenced NRCA publication are minimum standards, and shall not be construed as superseding the requirements depicted on the drawings and noted in the specifications.
 - 3. Daily reports:
 - a. A representative of the contractor or his designated subcontractor shall file daily reports each day that work included in this Section of the Specifications is executed. The daily reports shall be in accordance with the guidelines established by NRCA and shall be similar to those included in applicable NRCA quality control publications. The daily reports shall clearly demonstrate that the work complies with the requirements depicted on the drawings and noted in the specifications, and has been executed in accordance with referenced guidelines and standards. The use of applicable NRCA documents is encouraged and annotated applicable NRCA documents shall be deemed acceptable as a daily report. A sample of a typical daily report format is attached to this Section of the Specifications.
 - b. Daily reports shall be provided to the District at the end of each day that roofing work is executed.

C. Manufacturer's technical assistance:

1. The manufacturer of the roofing materials shall provide manufacturer's technical representative to attend necessary job meetings, assist with answering technical questions as they arise, perform periodic inspections as necessary, assist any third party independent inspector as may be required, and conduct a final inspection upon successful completion of the project.
 - a. The manufacturer's technical representative shall provide an inspection report after each site review and shall provide a copy of the inspection report to the District, the Contractor, the Architect-of-Record, and the District's independent consultant, if the District retains an independent roofing consultant or third party independent inspection agency. The inspection report shall be provided to all parties no later than twenty four hours after the inspection via email or fax.
2. Qualifications:
 - a. The manufacturer's technical representative shall be an employee of the roof membrane manufacturer who is technically qualified in the design, installation, and servicing of the roof membrane manufacturer's products. Personnel involved solely in sales do not qualify as a manufacturer's technical representative.
 - b. The manufacturer's technical representative shall be competent and thoroughly trained and experienced with regard to the work specified in this Section of the Specifications, and shall be completely familiar with general roofing requirements, the specified roofing products, and the methods needed for proper installation of the roofing system.
 - c. In lieu of providing a manufacturer's technical representative who is an employee of the roof membrane manufacturer, the roof membrane manufacturer may contract with an organization who specializes in providing technical assistance with regard to the design, installation, and servicing of the roof membrane manufacturer's products.

1.7 REGULATORY REQUIREMENTS AND SAFETY

- A. Compliance with regulatory requirements: Perform all roofing work in compliance with all applicable Federal, State, regional, and local statutes, laws, regulations, rules, and ordinances.
- B. Comply with applicable building codes and authorities having jurisdiction including amendments by local authorities. Unless otherwise specified or specifically approved by the local building authority having jurisdiction, comply with the latest edition of the applicable building code, standard, or regulation. Comply with applicable amendments by local jurisdictions as though they were specifically identified and included herein.

- C. In addition to complying with OSHA safety standards and regulations including but not limited to Section 29 CFR 1910 and applicable Cal/OSHA regulations comply with the following:
1. Provide sufficient temporary barricades in order to contain passage ways around tankers, trash chutes, hoisting areas, and areas below roof edges where work is executed.
 2. Provide an attendant at tankers and kettles at all times.
 3. Do not place kettles or tankers next to exterior building openings allowing fumes to enter the building. Do not allow fumes to enter the building at air intakes.
 4. Do not place kettles or tankers on roof decks. Coordinate the location of kettles and tankers with the District and obtain the District's approval for the location.
 5. Do not introduce flammable or explosive substances or equipment into a building of normally low or ordinary hazard classification while the building is occupied.
 6. A 2-hour fire watch is required after torch-on roofing.

1.8 SUBMITTALS

- A. See Section 01 33 00 Submittals Procedures.
- B. Do not begin work which requires submittals until submittals have been returned indicating the submittals have been reviewed.
- C. Submit the following prior to commencing roofing work:
1. Letter from the proposed primary roofing membrane manufacturer confirming that the roofing contractor or subcontractor is authorized to install the proposed system.
 2. Letter from the primary roofing membrane manufacturer stating that the proposed application will comply with the manufacturer's requirements in order to qualify the project for the specified guarantee.
 3. Submit documentation of manufacturer's proposed assembly based on substrate conditions as shown on Contract Documents. Such documentation shall indicate compliance with requirements as specified in the QUALITY CONTROL paragraph.
- D. Shop Drawings:
1. Submittals shall clearly show that the rigid insulation board and roof

membrane installation complies with the referenced specifications and standards in the QUALITY ASSURANCE paragraph.

2. Submit dimensioned shop drawings which shall include:

- a. Roof plan:
 - 1. Depicting an outline of the roof and roof size.
 - 2. For mechanically attached systems include wind loads, and boundaries of enhanced perimeter and corner attachments. Show the location and pattern of all fasteners.
- b. Proposed installation method for rigid insulation board if applicable and roof membrane plies for each different section of roof. Include fastener patterns.
- c. Shop drawings shall show installation details, and associated wood blocking and sheet metal assemblies for each condition encountered. The shop drawings shall clearly show all applicable dimensions.
- d. Shop drawings shall show fastening devices for each condition encountered.
- e. Omission in shop drawings of any materials shown on the design drawings, mentioned in specifications, or required for proper execution and completion of all roofing work does not relieve the Contractor of responsibility for providing such materials. The Contractor is responsible for the accuracy, dimensions, quantities, coordination with various trades, and conformance to project requirements.

E. Product data: Catalog sheets and specifications for each material specified.

F. Material Safety Data Sheets (MSDS): Submit an MSDS for each material specified, and for all other materials the Contractor intends to use in the execution of the work included in this Section of the Specifications.

G. Samples: Submit three samples of all specified materials to the District for approval. Submit samples of each type of mechanical fastener.

H. Submit manufacturer's application manual, which describes completely the preparation of surfaces and application of specified materials.

I. Submit a copy of the membrane manufacturer's warranty and a copy of the roofing contractor's warranty covering workmanship for review.

J. Fire hazard certification: Submit written certification that the roof system, including the specified rigid insulation board, has been tested in conjunction with the type of structural roof deck and roof slope applicable to the project and

has achieved an Underwriters Laboratories [UL] Class A external fire resistance rating.

- K. Wind uplift certification: Submit written certification that the roof system, including the specified rigid insulation board, has been tested in conjunction with the type of structural roof deck applicable to the project and has achieved a minimum of a Factory Mutual Class 1-90 Wind uplift rating.
- L. Rigid insulation board certification: Written certification from the manufacturer of the roof membrane that the rigid board insulation and the means of securing the rigid board insulation are approved for use with the specified roof membrane products. Attach applicable wind uplift and fire rating classification listings and approvals.
- M. Submit locations and name[s] of building owner[s] that demonstrate the roofing contractor complies with applicator qualifications as described in the QUALITY ASSURANCE paragraph.
- N. Submit "Certificate of Analysis" for all products supplied to the project site. The certificates shall state that the material being supplied is equal to or exceeds the physical and mechanical properties published in the manufacturer's published material specifications.
- O. Closeout submittals:
 - 1. Executed warranties.
 - 2. Maintenance guidelines and instructions.
 - 3. Information card; See attached sample.
- P. Deviations: Submit for approval proposed deviations from the specifications and design drawings. Deviations shall be clearly noted "PROPOSED DEVIATION". Proposed deviations that are submitted after the roofing system has been approved will be rejected. The District reserves the right to reject any or all deviations for any reason or no reason.

1.9 PRODUCT HANDLING

- A. See DIVISION 1, Material and Equipment.
- B. Ensure that overloading of the deck and structure does not occur due to and during application and storage of materials.
- C. Deliver all materials in manufacturer's original packaging in unbroken containers with clearly visible labeling. Avoid crushing or crinkling of roll materials. Do not remove materials from factory packaging until ready for use.

- D. Factory seconds or blems will not be accepted or allowed onsite.
- E. Store all rolled materials on end.
- F. Store all materials on raised platforms covered with properly secured breathable water resistant covers.
- G. Keep materials dry while they are transported, stored, and installed. Do not allow materials to be exposed to any moisture, anywhere, at any time. Use pallets and breathable water resistant material, canvas tarpaulins or similar material (not polyethylene), to cover all stored material, top and bottom. Do not permit condensation to accumulate in shrink wrapped packaging; slit shrink wrapping and cover with a breathable water resistant material. Materials that are exposed to moisture at any time shall be clearly marked as "rejected material" and shall be removed from the site.
- H. Handle all materials to avoid damage. Store rolled goods on ends only. Discard rolls which have been flattened, creased, or otherwise damaged.
- I. All materials must be clearly labeled with all pertinent information for specified roof system installation. Bituminous materials delivered in hot bulk equipment are to be accompanied by a certificate from the manufacturer clearly stating the type, quality, and stiffening point.
- J. Comply with PIMA Technical Bulletin #109 with regard to the handling and storage of polyiso roof insulation.

1.10 PROJECT CONDITIONS

- A. Schedule and perform work without exposing interior building areas to effects of inclement weather. The building and its contents shall be protected against risks, and damages shall be repaired or replaced at the sole expense of the Contractor. Exterior site improvements shall be protected from damage.
- B. Ensure that all surfaces to receive rigid insulation board, membrane plies, or flashing plies are clean and dry. Provide all equipment and labor to dry substrate surfaces prior to application of roofing materials. Do not apply any new roofing materials until the surface of the deck is clean, dry, and properly attached to the supporting structure. If any unusual conditions are discovered, stop work and promptly report this finding to the District.
- C. Do not apply roofing materials and flashings if moisture content of the substrate is above that recommended by the roofing membrane manufacturer or as specified herein. Wood or plywood shall be deemed "dry" if the moisture content is 15% or less.
- D. Do not apply roofing materials during inclement weather. Do not apply roofing materials to damp or frozen deck surface or when precipitation is forecast to

occur within 48 hours.

- E. Do not apply roofing materials when ambient temperature is below 40°F.
- F. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- G. Arrange work sequence to avoid use of newly constructed roof for storage, walking surface, and equipment movement. Protect surface with plywood runways where access is absolutely required, and ensure full protection of roofing surface against damage.
- H. Contractor shall test drains prior to and upon completion of roofing work to ensure that no blockage exists or has occurred.
- I. The Applicator shall verify that all roof drain lines are functioning correctly (not clogged or blocked) before starting work. Applicator shall report any such blockages in writing (letter copy to the manufacturer) to the District's Representative for corrective action prior to installation of the roof system.

1.11 PROTECTION REQUIREMENTS

- A. Protect the substrate from moisture and water at all times. Failure to protect the substrate from rain shall be deemed sufficient cause for rejecting the substrate.
- B. Torch safety:
 - 1. Comply with NRCA CERTA torch safety guidelines for application of roofing and flashing materials.
 - 2. Designate one person on each crew to perform a daily fire watch for all torch work. The designated crew member shall watch for fires or smoldering materials on all areas of roof construction. Continue the fire watch for a minimum one and one-half hours after torching work has been completed or for additional time as required to ensure no potential ignition conditions exist.
 - 3. If torching work is being executed do not leave the roof unattended at any time.
 - 4. Ensure any and all conditions related to potential ignition conditions are eliminated prior to leaving the roof at the end of each day.
- C. Membrane load protection:
 - 1. Do not support or lay equipment directly on the surface of the roof membrane. Equipment weighting more than two hundred pounds shall be supported as shown on the drawings and shall not be temporarily laid on a

protected roof membrane surface unless approved in writing by the District.

2. Provide plywood protection for all new and existing roof areas which receive traffic during construction.
- D. Protect newly applied roofing and adjacent surfaces against staining and mechanical damage throughout the execution this project.
- E. Provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas.
- F. Prevent access by the public to materials, tools, and equipment during the course of the project.

1.12 ENVIRONMENTAL CONDITIONS

- A. Do not apply roofing materials or rigid insulation board during precipitation or in the event there is a probability of precipitation during application. Take adequate precautions to ensure that roofing materials, incomplete and completed portions of the roofing system, and building interiors are protected from possible moisture damage.
- B. Temperature restrictions with regard to asphalt: At ambient temperatures of 40°F and below, special precautions must be taken to ensure that the specified Type IV asphalt maintains a minimum acceptable temperature of 410°F at the point of application of the sheet membrane. The asphalt must not be overheated to compensate for cold conditions; use insulated handling equipment. Use insulated hot luggers, mop carts, and kettle-to-roof supply lines. Hand mops should be constructed with a smaller yarn head to facilitate short moppings. Luggers and mop carts should never be more than half-filled at all times.

1.13 SEQUENCING

- A. Phased application of the roofing system [membrane plies] is prohibited unless otherwise approved by the District and the concurrence of the roof membrane manufacturer is obtained. Delays in application of the finish ply may result in requirements for additional cleaning and priming of the interply surface at the discretion of the District. The District shall not be liable for any additional costs the Contractor may incur related to additional cleaning or priming of the interply.
- B. Coordinate the work of this Section of the Specifications with all related work specified in other Sections of the Specifications to ensure that components which are to be secured to or stripped into the roofing system are available and that wood blocking, sheet metal flashing assemblies, and plumbing pipes, and roof drains are installed as the work progresses.

- C. Coordinate the preparation of submittals and the installation of rough carpentry, sheet metal, and plumbing work with other Sections of the Specifications.
- D. Ensure that temporary protection measures are in place to preclude moisture intrusion or damage to installed roofing materials, or incomplete and completed portions of the roofing system.

1.14 PRE-ROOFING CONFERENCE

- A. Prior to the beginning of the roofing work, a conference is to be held at the site, attended by the District or the District's designated representative, the Contractor, the Roofing and Sheet Metal Subcontractors (including foremen), a representative of the roofing manufacturer, and other party(ies) as the District may arrange for. The purpose of this conference shall be to review the specifications, details, application requirements, onsite inspection and/or testing requirements, and other pertinent aspects of the work. The Contractor shall make all arrangements and provide all facilities, for the meeting. All parties shall be notified in writing of date, time, and place at least 2 weeks before the proposed meeting.
- B. The specifications, roof plans, and all roofing and flashing details shall be reviewed at the pre-roofing conference. Any discrepancies between the contract documents and the manufacturer's specifications shall be discussed and resolved.
- C. Specific items to be discussed include:
 - 1. Administrative procedures and requirements:
 - a. Project schedule: Trade-related job schedules, and appropriate sequencing of the work, including timely installation [or removal and reinstallation] of any rooftop mechanical equipment or skylights to avoid or limit traffic on the roof.
 - b. Payment procedures.
 - c. Communications procedures.
 - d. Progress meetings.
 - e. Submittal procedures.
 - f. RFI procedures.
 - g. RFP procedures.
 - h. Requirements for a daily log/report.
 - 2. Safety requirements; review all related EPA and/or OSHA regulations and

other safety requirements, including considerations for safety of occupants.

3. Use of the project site:
 - a. Access.
 - b. Hours of construction.
 - c. Use of existing utilities and requirements for connections.
 - d. Scheduling of shutdown of utilities.
 - e. Site storage locations; areas on the job site that will be used for delivering, staging, and storing materials.
 - f. Temporary field office location.
 - g. Parking area for contractor's personnel.
 - h. Lunch area for contractor's personnel.
 - i. Location of kettle [only if hot asphalt is used].
4. Quality control:
 - a. Requirements for pre-roofing training.
 - b. Requirements for Quality Control reports.
 - c. Procedures related to the manufacturer's technical representative's inspections, pre-roofing training course, approval of substrate, distribution of inspection forms, and final acceptance.
 - d. Procedures related to 3rd Party inspection.
 - e. Appropriate weather conditions for executing the work.
 - f. Methods and procedures related to roofing installation, including manufacturer's written instructions.

1.15 PRE-ROOFING TRAINING

- A. Arrange for a representative of the roof membrane manufacturer to conduct a training session prior to the beginning of the roofing work. The training session shall include a detailed discussion and demonstrations regarding appropriate procedures for storing, applying, and protecting the specified roof membrane. In addition to reviewing roofing procedures, the representative of the roof membrane manufacturer shall review fire and safety regulations recommended by OSHA and NRCA, and other industry or local governmental groups to ensure

that every member of the application crew is familiar with the applicable regulations.

- B. All personnel who will be applying roofing materials shall attend the training session including the project foremen and superintendent. Only personnel who have attended the training session shall apply roofing materials. Any roofing materials specified in this Section of the Specifications that are applied by personnel who did not attend the training session will be rejected.
- C. Provide the District at least 72 hours notice of the scheduled time for the training session. Representatives of the District may choose to attend the training session and the contractor shall provide the required accommodations.
- D. Furnish to the District a list of all personnel who attended the training session.
- E. Do not proceed with roofing work until the training session has been completed and the District has been provided with a list of the attendees.

1.16 WARRANTY

A. Contractor warranty:

- 1. Submit written agreement signed by the installer and the Contractor, guaranteeing to correct failures in product and workmanship for a five [5] year period from date of substantial completion, without reducing or otherwise limiting other rights to correction which the District may have under the contract documents. The roofing system shall be guaranteed watertight and weatherproof. Provisions of the warranty must cover defects in workmanship and materials. In addition, the Contractor shall agree to undertake any and all corrective action required by poor workmanship or defective materials that may be uncovered by periodic inspections by the District for five years from date of acceptance of the roofing system even if roof leaks are not discovered during the warranty period.
- 2. Provisions of the warranty must cover the following:
 - a. Errors or defects in workmanship and in supplying roofing and flashing materials. The Contractor shall agree to undertake any and all corrective action required by poor workmanship or defective materials that may be uncovered by periodic inspections by the District or the District's designated representative for five years from date of acceptance of the roofing system even if roof leaks are not discovered during the warranty period.
 - b. Deterioration of the roofing system, including associated flashing assemblies, from customary and ordinary effects of wear and weather including damage due to extreme fluctuations in temperature. The Contractor shall agree to replace any and all deteriorated materials that

may be uncovered by periodic inspections by the District or the District's designated representative for five years from date of acceptance of the roofing system even if roof leaks are not discovered during the warranty period.

- c. Blisters, bare spots, buckles, wrinkles, and ridges, splits [unless caused by structural failure], in the roof membrane. The Contractor shall agree to undertake any and all corrective action required to correct or eliminate blisters, bare spots, buckles, wrinkles, splits [unless caused by structural failure], and ridges in the roof membrane that may be uncovered by periodic inspections by the District or the District's designated representative for five years from date of acceptance of the roofing system even if roof leaks are not discovered during the warranty period.
- d. Breaks in flashing plies where the flashing ply is adhered to sheet metal. The Contractor shall agree to undertake any and all corrective action required to correct or eliminate breaks in flashing plies where the flashing ply is adhered to sheet metal that may be uncovered by periodic inspections by the District or the District's designated representative for five years from date of acceptance of the roofing system even if roof leaks are not discovered during the warranty period.
- e. Slippage of the roof membrane including flashing plies. The Contractor shall agree to undertake any and all corrective action required to correct or eliminate slippage of the roof membrane, including flashing plies, that may be uncovered by periodic inspections by the District or the District's designated representative for five years from date of acceptance of the roofing system even if roof leaks are not discovered during the warranty period.
- f. Repairing damage to building interiors, contents of the building, and the roofing system due to water intrusion through the roof membrane and associated flashing assemblies.
- g. In the event that water intrusion occurs or the District uncovers any defect as described herein within the time period stipulated herein, the District will promptly notify the contractor in writing. The Contractor agrees to promptly inspect the roof system with a representative of the District, and to promptly make all necessary repairs at its own expense. All costs associated with the repair or replacement of the roof system and substrate shall be the joint responsibility of the Contractor and installer.

3. Contractor's and installer's maintenance inspection:

- a. Two maintenance inspections are required as follows: On or about two years and four years after the date of Substantial Completion the

Contractor and installer shall jointly inspect the roof with a representative of the District.

- b. The Contractor and/or installer shall correct any roofing system or flashing assembly deficiencies at no cost to the District. Roofing system or flashing assembly deficiencies include but are not limited to those noted in the NRCA "Repair Manual for Low-Slope Membrane Roof Systems". In addition, repair any blister exceeding 6" in any dimension and re-adhere all open seams.
- B. Roof membrane manufacturer's warranty: Provide manufacturer's non-prorated fifteen year unlimited penal sum guarantee with no deductible and no dollar limit. This warranty shall not exclude random areas of ponding from coverage.
- C. It is mutually understood that the following may be excluded from any warranties, but the exclusion shall apply only if the following are the sole cause of failure of the roof membrane assembly:
 1. Natural disasters including but not limited to floods, lightning, hurricane force winds, windstorms as defined in applicable FM literature (localized occurrences of wind speeds exceeding 74 mph), earthquakes, and tornadoes. This exclusion applies only if the contractor or membrane manufacturer providing the warranty can demonstrate that the natural disasters could not have been reasonably anticipated as part of local weather and climactic patterns in the geographic area in which the building or buildings are located.
 2. Structural failures such as cracks in decks, walls, and foundations.
 3. Storage of materials by the District on the roof after substantial completion.
 4. Erection of any additional construction assembly on or through the roof assembly after the date of substantial completion unless the erection of any additional construction assembly is in a manner prescribed by the contractor and the roof membrane manufacturer providing the warranties and the contractor and roof membrane manufacturer providing the warranties are provided written notification and the opportunity to review the scope of the proposed additional construction prior to execution of the construction work.
 5. Damage due to modifications to existing mechanical and electrical assemblies located on the roof after the date of substantial completion unless the modifications are executed in a manner prescribed by the contractor and roof membrane manufacturer providing the warranties and the contractor and roof membrane manufacturer providing the warranties are provided written notification and the opportunity to review the scope of the proposed modifications prior to execution of the construction work.
 6. Use of the roof, or any part thereof, for a purpose for which it was not

intended.

7. Additions, alterations, or repairs to the roof membrane assembly [excepting emergency repairs to halt water intrusion] authorized by anyone except the contractor and/or the roof membrane manufacturer.

PART 2 - PRODUCTS

2.1 ROOFING SYSTEM

A. General:

1. This section of the specifications establishes minimum standards for the sheet roofing membrane system. This specification is based on a modified bitumen membrane system and warranties as noted herein shall be provided for the roof.
2. No asbestos containing materials shall be used in the execution of the work included in this Section of the Specifications.

B. Approved manufacturers: Siplast, Soprema, Garland, or Tremco:

1. The reference to manufacturer's materials on the drawings or in the specifications shall not be construed as allowing any work that does not comply with the requirements for the application of roofing materials as depicted on the drawings and specified in the specifications.
2. The roofing system shall include only materials of a single manufacturer.

C. Roofing membrane assembly: A roof membrane assembly consisting of a minimum of two plies of a prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane, secured to a prepared substrate. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen interply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system. The modified bitumen finish ply or cap sheet shall be fully adhered to the modified bitumen interply.

D. Base Sheet: See PART 4 - TABLE OF APPROVED MATERIALS.

E. Modified bitumen interply: See PART 4 - TABLE OF APPROVED MATERIALS.

F. Modified bitumen finish ply (cap sheet): See PART 4 - TABLE OF APPROVED MATERIALS.

G. Mopping asphalt: Certify asphalt for full compliance with the requirements for Type IV asphalt listed in Table I, ASTM D 312-16a; See PART 4 - TABLE OF

APPROVED MATERIALS.

- H. Primer: A high flash, quick drying, asphalt solvent blend which meets or exceeds ASTM D 41 -11(2016) requirements; See PART 4 - TABLE OF APPROVED MATERIALS.
- I. Mastic: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting sheet metal flanges and conforming to ASTM D 4586-

2.2 FLASHING SYSTEMS

- A. Stripping plies: Same as modified bitumen interply except use torch grade plies at base flashings that extend onto vertical surfaces.
- B. Finish flashing ply: See PART 4 - TABLE OF APPROVED MATERIALS except use torch grade plies at base flashings that extend onto vertical surfaces.

2.3 RIGID INSULATION BOARD

- A. Provide rigid insulation boards that are approved in writing by the manufacturer of the rigid insulation board for use as part of a modified bitumen roofing system, and are approved by the roof membrane manufacturer for use with the specified roof materials. Provide rigid insulation board, including tapered systems, that comply with the following:
 - 1. Polyisocyanurate complying with product standard ASTM C 1289 Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board, Type II Class 1, Grade 2; minimum compressive strength shall be 20 psi.
 - 2. California State Insulation Quality Standards and Title 25 Foam Flammability Criteria.
 - 3. Applicable sections of the California Building Code with regard to foam insulation.
 - 4. UL labeled and listed in applicable UL publications as meeting the applicable flame spread and smoke development rating. Testing shall be in accordance with ASTM E 84:
 - a. Compliance with flame spread and smoke developed ratings is not required when the insulation has been tested as part of a roof construction assembly of the type specified for this project and the assembly is listed as fire-classified as specified herein in applicable UL publications.
- B. Maintain a maximum panel size of 4' by 4'.

C. Tapered rigid insulation board:

1. One layer shall be factory tapered to the slope shown on the drawings; not less than one 1/4 inch per foot [1:48].
2. Provide starter and filler blocks as required to provide the total thickness of rigid insulation board necessary to meet the required slope.
3. Mitered joints shall be factory fabricated and shall consist of two diagonally cut rigid insulation boards or one rigid insulation board cut or shaped to provide the required slope.

D. Cover board: DuraBoard manufactured by Johns Manville meeting ASTM C 728; minimum thickness 3/4".

2.4 FASTENERS

A. General:

1. Comply with the QUALITY ASSURANCE paragraph.
2. Comply with applicable galvanizing standards; zinc coated per applicable ASTM.
3. Form to allow the fastener head to be recessed into the plate after the fastener has been driven.

B. Roofing nails of galvanized steel, 11 or 12 gauge: spiral, annular or barbed shank, 1" diameter round or square cap, length to suit substrate; long enough to penetrate through the plywood by at least 3/4". At wood members the fasteners shall be long enough to penetrate the wood member a minimum of 1-1/2".

C. Staples: Galvanized steel; size and type as required by the specific fastening condition.

D. For gypsum roof sheathing at steel decks: FM approved hardened, corrosion resistant screws. Comply with the requirements noted in the QUALITY ASSURANCE paragraph with regard to size and type.

2.5 MISCELLANEOUS

A. Protection layer: Red rosin heavyweight building paper weighing not less than 4#/100 SF, or roof sheathing paper weighing not less than 6#/100 SF.

B. Tapered edge strips: Provide perlite tapered edge strips at all parapet walls, curbs, expansion joints, as recommended by membrane manufacturer, and as shown on the drawings.

- C. Cants: Provide preformed 45° perlite cant strips at all parapet walls, curbs, expansion joints, as recommended by membrane manufacturer, and as shown on the drawings.
- D. Traffic Pads: A prefabricated, puncture resistant polyester core reinforced, polymer modified bitumen sheet material topped with a ceramic-coated granule wearing surface; See PART 4 - TABLE OF APPROVED MATERIALS.
- E. Elastomeric flashing tape: As noted herein and on the drawings:
 - 1. BRT801 black HDPE faced butyl flashing tape manufactured by Carlisle Coatings and Waterproofing. Color shall be black.
 - 2. Miscellaneous elastomeric flashings and tapes as noted on the drawings.
- F. Sealant:
 - 1. Moisture-curing, non-slump elastomeric sealant designed for roofing applications.
 - 2. Chem-Calk 300: Use to seal sheet metal interfaces to any material that contains asphalt (roof plies).
- G. Large pipe and conduit supports: MIRO Industries Model 6-RAH 8 and 6-RAH 12 SS unless otherwise specifically noted on the drawings.
- H. Small pipes and conduit supports: Portable Pipe Hangers, MIRO Industries Model 3-R (for single pipes or conduits), or Thaler Metal Industries Mers 707 unless otherwise specifically noted on the drawings.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that roof substrate has been properly fastened, and that site conditions are ready to receive roofing work. Contractor to confirm that site conditions and substrates are ready for roofing work to commence. If not, make suitable repairs or adjustments to the work.
- B. Verify that roof substrate is clean and smooth, free of depressions, waves, or projections, and properly sloped to drains.
- C. Verify that roof substrate surfaces are dry.
- D. Verify that preservative treated wood nailers and wood blocking are in place and will permit the nailing of flashing assemblies at a minimum height of 8" above the finished roof surface unless otherwise noted on the drawings.

- E. Verify that all curbs for rooftop mounted mechanical equipment and skylights have been installed.
- F. Verify that roof openings, curbs, pipes, sleeves, ducts, and vents through the roof are solidly set, and cant strips are in place.
- G. Examine surfaces for conditions that will adversely affect execution, permanence, and quality of work.
- H. Do not commence application of the roofing system until all rough carpentry work, required to complete curbs for rooftop mounted mechanical equipment and skylights, and parapet walls, has been completed.
- I. Correct unsatisfactory conditions before proceeding with the Work.

3.2 INSPECTION OF SUBSTRATE

- A. Prior to starting installing roofing materials specified herein, the Contractor, the installer, the manufacturer's technical representative, and a representative of the District shall meet at the job-site and examine all surfaces over which roofing materials specified herein will be installed, and adjoining surfaces which will be affected by the roofing work. Correct all unacceptable surfaces and/or conditions prior to the start of the work specified herein.
- B. If unacceptable surfaces and/or conditions are identified, and after the Contractor has made the required corrections, the Contractor, the installer, the manufacturer's technical representative, and a representative of the District shall make another inspection. If during the reinspection unacceptable surfaces and/or conditions are identified proceed as noted herein. Manufacturer's technical representative to report in writing to the District any defects which may adversely affect the completion or performance of the specified work. Absence of such notification will be construed as acceptance of the work in place.
- C. In the event of a re-roof, care must be given to identify any ponding or run-off problems. Prior to the tear-off of the existing roof, Contractor to flood the roof and identify pre-existing ponding and other drainage conditions that are to be corrected. The flooding of the roof is to be done in the presence of the District, Architect (and construction or project manager), and documented by the Architect.

3.3 PROTECTION

- A. Install a protection layer over the existing substrate to prevent asphalt from entering the building interiors and as required to prevent asphalt seeping under the protection layer. The protection layer sheets shall be lapped, sealed with a tape or other material, and secured to the substrate as required to comply with the requirements noted herein. Seal joints in and at edges of the deck if there is

a likelihood of asphalt drippage into the building or down exterior walls.

- B. Protect adjacent metal, glass, painted surfaces and other finish materials within wind-borne range of bitumen.
- C. Protect neighboring work, properties, vehicles, and persons from spills and wind-borne bitumen.
- D. Protect roof deck from rain and moisture when weather threatens. Provide adequate weather protection to ensure plywood substrate is protected from rain and water, and that the plywood substrate does not come in contact with water at any time. Failure to protect the substrate or roofing system from rain and moisture will result in the removal of all materials that have absorbed water or come in contact with water.
- E. Remove debris from the roof deck and the project site on a daily basis and dispose of in a legal manner.

3.4 BASE SHEET

- A. Install a base sheet under all rigid insulation board and modified bitumen roof ply assemblies, and at all areas as noted on the drawings.
- B. Fasten the base sheet to the substrate using mechanical fasteners unless specifically otherwise noted on the drawings, in accordance with the requirements noted in the QUALITY ASSURANCE paragraph and as further noted herein.
- C. Lay the base sheet over entire area to be roofed, lapping sides and ends 4". Base sheet shall be allowed to relax for 1 hour prior to fastening to substrate. After base sheet has been fastened to the substrate, it shall be smooth, free of wrinkles, and suitable for application of the rigid insulation board or roof membrane.
- D. Only install an amount of base sheet sufficient to allow for application of rigid insulation board, if included in the project, and the roof membrane before the end of the day's work.
- E. The requirements described herein establish minimum standards for installation of the base sheet. If referenced standards or manufacturer's recommendations are more stringent, comply with the most stringent requirement.
- F. Do not allow any base sheet to be exposed to the exterior elements at the end of the day's work. Remove any base sheet that is exposed to the exterior elements overnight and replaced with new base sheet. Do not use the base sheet as a temporary roof.

3.5 GENERAL WORKMANSHIP

- A. Do not work in rain or temperatures below 40°F.
- B. Do not allow any water, dew, or frost to be present while executing the work.
- C. Do not allow materials or incomplete roofing work to be exposed to any moisture, anywhere, at any time. Proceed with flashing work immediately as roofing is installed.
- D. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this project. Make necessary preparations, utilize recommended application techniques, apply the specified materials, and exercise care in ensuring that the finished appearance is agreeable to District.

3.6 INSTALLATION OF RIGID INSULATION BOARD

- A. Adhere rigid insulation boards using hot bitumen.
- B. Comply with the rigid insulation board and roof membrane manufacturers' guidelines and recommendations, and referenced guidelines and standards. In addition comply with the following:
 - 1. The maximum size of an individual board of rigid insulation board shall be 4' x 4'.
 - 2. Set rigid insulation board in hot Type III or Type IV asphalt. Apply the asphalt in accordance with the Equiviscous Temperature (EVT) concept and applied within the EVT temperature range ($EVT \pm 25^{\circ}F$). Asphalt application shall result in approximately 30 lbs. of asphalt ($\pm 25\%$ on a total job average basis) per roof square beneath each layer. Firmly embed each layer of rigid insulation board in a solid asphalt mopping as described herein. Mop only a sufficient area to provide complete embedment of one board at a time.
 - 3. Apply rigid insulation board in a minimum of two layers with staggered joints. When using multiple layer of rigid insulation boards, joints of each succeeding layer shall parallel and vertically offset a minimum distance of 6" in both directions with respect to the layer below.
 - 4. Install rigid insulation board with sides and ends touching along their lengths. Stagger end joints between adjacent rigid insulation boards. Edges of abutting rigid insulation boards should be in moderate contact. Gaps shall not be greater than 1/4".
 - 5. Cut and miter rigid insulation boards to fit and fill neatly all surfaces including ridges, irregular surfaces, perimeter blocking, mechanical equipment, and protrusions.

6. Trim surfaces of rigid insulation board as necessary at roof drains such that the completed surface is flush and does not restrict the flow of water.
 7. Remove rigid insulation boards with broken corners or similar defects and replaced unless the defect can be trimmed and repaired to the satisfaction of the District.
 8. The maximum deviation between adjacent rigid insulation board panels shall be 1/16".
- C. Cover installed rigid insulation boards with the cover board and roof membrane by the end of each day's work. Remove installed rigid insulation boards that are not covered with the cover board and roof membrane by the end of each day's work prior to the start of the following day's work and shall be replaced with new rigid insulation boards:
1. Remove installed rigid insulation boards that are moist or wet and replace with new rigid insulation boards.
- D. Protection with Nightly Tie-Offs: Install membrane tie-off ply or plies at the end of each day's work as specified herein, adhered to the roof membrane, and adhered or sealed onto the top [bearing] surface of the substrate, to protect the exposed ends of rigid insulation boards that have been applied that day. Remove entirely the tie-offs before additional rigid insulation board is applied.
- E. All requirements for the installation of rigid insulation board apply to the installation of the cover board.

3.7 SUBSTRATE PREPARATION

- A. Comply with roof membrane manufacturer's published instructions for preparation of substrates to receive modified bituminous sheet roofing.
- B. Prior to priming, clean substrate of all dust, and debris. Remove other substances detrimental to roofing work.
- C. Remove surface irregularities that may damage roofing materials or cause application defects.
- D. Prime substrate if recommended by the roof membrane manufacturer's guidelines and recommendations, and referenced guidelines and standards.

3.8 APPLICATION - GENERAL

- A. General: Comply the requirements of the QUALITY ASSURANCE paragraph, with the manufacturer's written instructions, and as noted herein:
 1. Application of roofing plies shall immediately follow application of the rigid

insulation board and/or cover board as a continuous operation.

2. Apply all roofing plies using hot asphalt.
3. Laps shall be as recommended by the manufacturer and as specified herein.
4. Asphalt shall bleed out in a continuous line about 1/4" wide beyond the edge of the sheet.
5. Prime sheet metal flanges with a uniform coating of ASTM D 41 asphalt primer.
6. Cutting or alterations of bitumen, primer, and sealants is not permitted.
7. Install cant strips at the intersection with curbs, walls, and parapets. Cant strips shall be continuous, and set in a heavy mopping of hot asphalt as specified for the rigid insulation board.

B. The following establishes minimum requirements:

1. Apply all layers of roofing free of wrinkles, creases or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets. Lap seams in the interply layers should not coincide with the lap seams of the finish ply layer. Stagger courses a minimum of 12" to ensure this.
2. Asphalt:
 - a. Kettles shall be equipped with accurate, fully readable thermometers. Asphalt shall not be heated to or above its flash point. Avoid heating at or above the FBT, should conditions make this impractical, heating must be no more than 20°F below the EVT and no more than 20°F above EVT.
 - b. Asphalt temperatures: If the EVT information is not provided, the following asphalt temperature shall be observed. Maximum heating temperature shall be 525°F. Minimum application temperature shall be 410°F. Continuously verify the application temperature of the asphalt at the point of application with a thermometer.
3. Moppings:
 - a. Ensure that all moppings do not exceed a maximum of thirty pounds/square. Mopping shall be total in coverage, leaving no breaks or voids.
 - b. When mopping, the temperature of the asphalt at the point of fusing of the interply to the cover board, or fusing the interply to the finish ply shall not be lower than 410°F to ensure a permanent bond. Asphalt

temperatures that are lower than those noted herein shall be sufficient cause for rejecting the work.

- c. When rolling the membrane into a mopping of hot asphalt, the hot asphalt shall not extend more than 4' in front of the membrane. As sheets are being rolled into the hot asphalt, immediately and thoroughly apply uniform positive pressure to ensure full adhesion, and eliminate entrapped air. Provide tight, smooth, and fully bonded laminations.

4. INTERPLY:

- a. Begin application at lowpoint of roof.
- b. Apply all layers of roofing parallel to the slope of the deck.
- c. Fully bond the interply to the prepared substrate, having a minimum of 3" side and 6" end laps.
- d. Stagger end laps a minimum of 3'.
- e. Cut dog ear angles on underlying end laps at the finish edge and the overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application.
- f. Lay the interply loose on cants [not adhered].
- g. Check all lap seams after installation, and correct all defects.
- h. Before application of the finish ply, check all roof slopes to ensure positive slope to drainage outlets as described on the drawings. Build-up all areas where additional positive slope is required by mopping in place one or more additional layers of the interply as described herein.

5. FINISH PLY:

- a. Begin application at lowpoint of roof.
- b. Apply all layers of roofing parallel to the slope of the deck.
- c. Fully bond the interply to the prepared substrate, having a minimum of 3" side and 6" end laps.
- d. Stagger end laps a minimum of 3'.
- e. Stagger side laps of the finish ply a minimum 12" from side laps in the underlying base ply.
- f. Cut dog ear angles on underlying end laps at the finish edge and the overlapping selvage edges. Using a clean trowel, apply top pressure to

top seal T-laps immediately following sheet application.

- g. Broadcast mineral granules over all bitumen overruns on the finish ply surface to ensure a monolithic surface color.
- h. After installation check all lap seams, and correct all defects.

6. FINISH FLASHING PLY:

- a. Exert sufficient pressure on the finish flashing sheet to ensure the prevention of air pockets.
- b. Prime all end laps of the finish flashing sheet with a uniform coating of the specified asphalt primer and allow to thoroughly dry prior to overlapping of adjoining sheets.
- c. Heat fuse all side laps of the finish flashing sheet to ensure a complete seal.

7. Nail roofing membrane plies on vertical surfaces as noted on the drawings, as recommended by the roof membrane manufacturer, and in accordance with NRCA recommendations.

8. Walkway pads: Set in cold adhesive, or use an alternate method if recommended by the roof membrane manufacturer.

C. Schedule inspections and field tests, if required, for the roofing system with independent testing agencies, and cooperate with the testing agency personnel during field visits.

D. Prevent roofing materials from damaging or spilling on adjacent construction. Replace adjoining materials damaged by installation of the roofing system.

3.9 FLASHINGS

A. Comply with NRCA referenced standards, manufacturer's recommendations, additional requirements specified in this Section of the Specifications and in other Sections of the Specifications, and the flashing requirements as depicted on the drawings. Sheet metal flashings are specified in applicable Sections of the Specifications and as noted on the drawings.

B. Apply flashing plies from the low point of the roof to the high point so that all laps shed water. As the flashing ply is being applied, it must be pressed firmly against the substrate to maximize the adhesion. Particular attention must be taken while the flashing ply is being installed to prevent possible tenting that is a result of stress put on the membrane when the flashing ply is applied improperly.

C. Base flashing assembly: Provide two-ply base flashings at all locations as

depicted on the drawings. The first ply shall be a torch grade interply extending a minimum of 4" beyond the cant onto the field of the roof. The second ply shall be a torch grade finish flashing ply extending a minimum of 6" beyond the cant onto the field of the roof:

1. Prime surfaces to receive flashing plies as recommended by the roof membrane manufacturer.
2. Embed granules of the receiving sheet as recommended by the membrane manufacturer prior to forming laps at granulated surfaces.
3. Mechanically anchor base flashings a maximum of 8" on center along the top edge at all vertical surfaces unless otherwise shown on the drawings. Apply a layer of flashing cement to extend 1" above the top edge of the base flashings to a line 1" below the nail heads.

D. Sheet metal flanges:

1. Support sheet metal flanges, unless otherwise shown on the drawings, using continuous preservative treated wood blocking or plywood securely fastened to the substrate. Do not extend sheet metal flanges over cover board.
2. Fabricate sheet metal assemblies embedded in the roofing system, unless otherwise shown on the drawings, such that at least a 4" flange is embedded in the roofing system.
3. Set flanges of sheet flashing assemblies in a bed of roofing cement or mastic.
4. Seal sheet metal laps in embedded sheet metal flanges with an asphalt compatible urethane or butyl sealant unless otherwise recommended by the membrane manufacturer.
5. Nail sheet metal flanges as shown on the drawings, except for sheet metal flanges fabricated from lead or as noted herein. Minimum nailing shall be two rows of ring shank nails securely embedded in the substrate; nailing shall be 4" on center in each row, and the nails in each row shall be offset 2" from the nails in the other row.
6. Strip-in sheet metal flanges with the application of the interply.

E. Wall flashing:

1. Flash walls and curbs using a stripping ply and the finish flashing ply. After the interply has been applied to the top of the cant, fully adhere the stripping ply using a torch, utilizing minimum 3" side laps and extend a minimum of 4" onto the base ply surface, or as shown on the drawings, and up the parapet wall above the cant as shown on the drawings; minimum

extension up the parapet wall is 8" above the field of the roof.

2. After the interply, stripping plies, and the finish ply have been applied, prepare the surface area that is to receive finish flashing ply by torch heating granular surfaces or by application of asphalt primer; allowing primer to dry thoroughly. Torch apply the finish flashing ply into place using 3' widths (cut off the end of roll) always lapping the factory selvage edge. Stagger the laps of the finish flashing ply from lap seams in the underlying ply. Extend the finish flashing ply a minimum of 6" beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the finished flashing ply during application to ensure complete contact with the wall/roof surfaces, preventing air pockets. Nail the top edge of the flashing on 8" centers.
- F. Drain flashing: Install drain flashing as recommended by the manufacturer, NRCA, and as shown on the drawings. Set in 30" x 30" lead flashing sheet in bed of roofing cement on completed modified bituminous interply. Cover lead sheet with a modified bituminous stripping ply, with the stripping ply extending a minimum of 4" beyond the edge of the lead flashing onto the roof membrane.
- G. Field curing neoprene sheet flashing: Install field curing neoprene sheet flashing at locations as shown on the drawings. To attach the neoprene sheet to metal surfaces, clean and prime the metal surfaces with primer if recommended by the manufacturer of the field curing neoprene sheet flashing. Then apply a full coat of neoprene adhesive to the metal and the back of the neoprene sheet. Allow the adhesive to "tack" dry. Press the neoprene into place and roll it into firm contact with a metal roller. Caulk all exposed neoprene sheet edges as recommended by the manufacturer of the field curing neoprene sheet. Cleaner is to be used only for cleaning and not for thinning primer or adhesive.

3.10 SMALL PIPE AND CONDUIT SUPPORTS

- A. Support all pipe lines and conduits which run horizontally on the roof using the specified pipe and conduit supports, or the pipe and conduit supports shown on the drawings. Pipe and conduit supports shall be set on walktread pads. Cut each walktread pad to a size which extends a minimum of 4" beyond the perimeter of the pipe support. The spacing for the pipe supports shall be of adequate distance to prevent sagging of the pipe and to prevent the pipe support from coming into contact with the new roof system. Set the walktread dry over the new roof system. See the drawings.

3.11 WATER CUT-OFF

- A. Construct a water cut-off at all open edges at the end of the day's work or when precipitation is eminent. Construct the cut-off with the same membrane and asphalt as that used for the roofing system. Cut-off must be able to withstand extended periods of wet weather. The water cut-off shall be completely removed

prior to resuming the installation of the roofing system.

3.12 JOB COMPLETION

- A. Inspect the completed roofing system and correct all defects to meet the requirements of this Section of the Specifications.
- B. Arrange for a representative of the membrane manufacturer to inspect the completed roofing system and notify the Contractor of any defects in the application.
- C. Restrict construction traffic and equipment movement on the completed roofing system to only essential personnel. Provide appropriate protection against traffic and construction activities on completed roofs.
- D. Cleaning and protection:
 - 1. Clean up all debris, excess materials, and equipment and remove from site.
 - 2. Clean any drips or spills of asphalt or primers. Asphalt runs, sags, and streaks shall be carefully removed from adjoining surfaces such as not to damage the adjacent surface.
 - 3. Any work or materials that were damaged in the execution of work included in this Section of the Specifications shall be restored to their original undamaged condition or replaced with new work or materials.

3.13 ROOF CONSTRUCTION MONITORING

- A. The Contractor shall undertake periodic inspections as required to ensure the work of this Section of the Specifications is executed as required and described herein. If recurring deficiencies are found, the Contractor shall implement measures the Contractor deems necessary to correct the deficiencies and to ensure that the work is executed in a manner as required and described herein.
- B. Intent of Contractor's periodic inspections:
 - 1. Confirm that roofing materials comply with specified requirements.
 - 2. Confirm that roofing materials are properly stored, handled, and protected from moisture or damage.
 - 3. Confirm that roofing materials are not installed during adverse weather conditions.
 - 4. Confirm that substrates are acceptable and comply with specified requirements.

5. Confirm that wood nailers and blocking have been provided and installed as required.
6. Confirm that the roofing system and required inspections comply with the specified requirements.
7. Confirm that temporary protection requirements are in place at the end of each working day.

3.14 FIELD QUALITY CONTROL

- A. Notify the manufacturer by means of manufacturer's printed Notification of Completion form of job completion in order to schedule a final inspection date.
- B. Hold a meeting at the completion of the project, attended by all parties that were present at the pre-job conference. Compile a punch list of items required for completion. Complete, sign, and mail the punch list form to the manufacturer's headquarters.
- C. If required by the roofing membrane manufacturer as part of the warranty, perform test cuts and evaluation procedures in accordance with ASTM D3617 and Chapter V, "Quality Control," of The NRCA Low-Slope Roofing Manual:
 1. The following establishes criteria for voids in the interply in accordance with ASTM D3617:
 - a. Overlapping voids between two or more plies are not acceptable.
 - b. The maximum acceptable length of any individual void is 2".
 - c. The total length of all voids shall not be greater than 4" between any two plies.
 - d. Dry voids (the absence of bitumen/adhesive between plies) are not acceptable.
 - e. Moisture in voids is not acceptable.
 2. In addition to voids the following defects are not acceptable:
 - a. Wrinkles, ridges, and ripples of any length.
 - b. Sagging at vertical surfaces.
 - c. Granule loss; finish ply.
- D. If additional inspections are required by the roofing membrane manufacturer to comply with the requirements of the WARRANTY specified in this Section of the Specifications, perform all required inspections at no additional cost to the

District.

3.15 PROTECTION AND CLEANING

- A. Protect the roofing system from damage and wear during the duration of the construction.
- B. Repair or replace (as required) roofing work damaged during the execution of the construction work.
- C. Clean overspray or spillage from adjacent construction using cleaning agents and procedures recommended by the roof membrane manufacturer, or replace damaged roofing materials.

3.16 FINAL INSPECTION

- A. At the end of the construction period, the Contractor shall make a final inspection of the new roofing system and prepare a written report to the District describing the nature and extent of damage found in the work, if any. Repair or replace defective roofing work found at the time of final inspection.

PART 4 - SCHEDULE OF APPROVED MATERIALS

TABLE OF APPROVED MATERIALS				
Material	Siplast	Soprema	Garland Co	Tremco
Base sheet	Irex 40; ceramic granules in contact with the substrate or approved equal [as required to achieve a Class A Fire Hazard Classification]	ceramic granules in contact with the substrate or approved equal [as required to achieve a Class A Fire Hazard Classification]	ceramic granules in contact with the substrate or approved equal [as required to achieve a Class A Fire Hazard Classification]	ceramic granules in contact with the substrate or approved equal [as required to achieve a Class A Fire Hazard Classification]
Interply	Paradiene 20 EG	Sopralene 250 Sanded	Stressply EUV	POWERply
Finish Ply	Paradiene 30 CR FR	SopraStar	Stressply EUV FR Mineral with Pyramic white fire resistant polymeric coating	POWERply T-
Finish Flashing Ply	Veral flashing systems - Veral Aluminum	Sopralast 50 TV ALU	Heavy flashing ply as recommended by the manufacturer	Heavy flashing ply as recommended by the manufacturer
Traffic Pads	Siplast Paratread Roof Protection Material	Soprawalk	Heavy flashing ply as recommended by the manufacturer	
Mopping Asphalt	Siplast PA-1000 Polymer Modified		Hot Stuff Asphalt, Type IV	
Asphalt Primer	Siplast PA-1125	Elastocol Series	as recommended by the roof membrane manufacturer	as recommended by the roof membrane manufacturer
Mastic		Sopremastic SBS Elastic Cement	as recommended by the roof membrane manufacturer	Wet and Dry Asphalt Mastic

END OF SECTION

At completion of work under this Section, provide filled-in information card to the District in a format similar to that depicted below.

INFORMATION CARD

MODIFIED BITUMEN ROOFING SYSTEM COMPONENTS

BUILDING NUMBER:

ROOF NUMBER:

SUBSTRATE

Deck Type:

Deck Slope:

Sheathing Paper: [] Yes [] No

INSULATION

Insulation Manufacturer:

Insulation Thickness:

Insulation Type:

Insulation R-Value:

SHEET MATERIALS TYPE AND MANUFACTURER:

Base Sheet:

Interply Sheet:

Cap Sheet:

Flashing Sheet:

Bituminous Materials Manufacturer:

Primer:

Flashing Cement:

Statement of Compliance or Exceptions [attach]: [] Yes [] No

Date of Substantial Completion:

Guaranty Period:

Roofing Subcontractor: Attach name, address, and phone number

Signature _____

General Contractor: Attach name, address, and phone number

Signature _____

Roofing Manufacturer: Attach name, address, and phone number

Signature _____

SECTION 07 62 00
Sheet Metal Flashing and Trim

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pre-coated cap flashings.
- B. Counterflashings at piping penetrations, vent pipes, and conduits.
- C. Counterflashings over bituminous base flashings.
- D. Counterflashings at roof mounted equipment, curbs and supports.
- E. Flexible sheet flashing.
- F. Manufactured reglets.
- G. Sill-pans (sheet metal sub-pans) for windows and storefront units.

1.2 REFERENCES

Contractor's work shall comply with the following standards as applicable.

Manufactured items are to be fabricated to these same standards.

The following standards (and publications) are applicable to the extent referenced in the text. The most recent of these standards is implied, unless otherwise stated.

- A. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated, (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM A755 - Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
- C. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated (Galvanized) by the Hot-Dip Process.
- D. ASTM B32 - Standard Specification for Solder Metal.
- E. ASTM B101 - Standard Specifications for Lead-Coated Copper Sheet and Strip for Building Construction.
- F. ASTM D226 - Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

- G. ASTM D4586 - Standard Specification for Asphalt Roof Cement, Asbestos Free.
- H. SMACNA - Architectural Sheet Metal Manual.

1.3 SYSTEM DESCRIPTION

- A. Work of this Section is to physically protect [membrane roofing,] [pre-formed metal roofing] [and] [base flashings,] from damage that would permit water leakage to building interior.

1.4 QUALITY ASSURANCE

- A. Applicator: Company specializing in sheet metal flashing Work with five years minimum experience.
- B. Perform Work in accordance with SMACNA standard details and requirements.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Submit Shop Drawings of sheet metal items indicating profiles, jointing, terminations, sill pans and installation details. Indicate type and spacing of fasteners.
- C. Submittal of specific plates from the SMACNA Architectural Sheet Metal Manual constitutes acceptable documentation of installation details.
- D. Submit Product Data for pre-coated galvanized steel and flashing accessories.
- E. Submit two 4" square Samples illustrating metal finish color for pre-coated steel.

1.6 STORAGE AND HANDLING

- A. Store products under provisions of Section 01 87 00.
- B. Stack preformed material to prevent twisting, bending, or abrasion, and to provide ventilation.
- C. Prevent contact with materials during storage which may cause discoloration, staining, or damage.

1.7 WARRANTY

- A. Provide manufacturer's 20-year warranty against defective materials and finish.
- B. Provide installer's 2-year warranty coverage for water tightness and integrity of seals.

PART 2 - PRODUCTS

2.1 SHEET MATERIALS

- A. Galvanized Steel: ASTM A653, Grade 33, G90 zinc coating in accordance with ASTM A924, 0.0299" thick core steel.

2.2 ACCESSORIES

- A. Lead-Coated Copper: ASTM B101, Temper H00 and H01, cold-rolled copper sheet, coated both sides with lead weighing not less than 12 pounds per 100 square feet or more than 15 pounds per 100 square feet total weight of copper sheet with lead applied to both sides.
- B. Fastener: Galvanized steel or stainless steel with soft neoprene washers at exposed fasteners. [Finish exposed fasteners shall match pre-coated metal.]
- C. Underlayment: ASTM D266; No. 30 asphalt-saturated roofing felt.
- D. Metal Primer: As specified in Section 09 91 00.
- E. Protective Backing Paint: Zinc chromate alkyd.
- F. Slip Sheet: 0.05 psf, rosin-sized building paper.
- G. Sealant: As specified in Section 07 92 00.
- H. Bedding Compound: Rubber-asphalt type.
- I. Plastic Cement: ASTM D4586, Type I.
- J. Metal Flashing System: Two piece pre-coated galvanized steel similar to Springlok Flashing System, manufactured by Fry Reglet, type as indicated. Include fabricated end closures and mitered corners.
- K. Solder for Lead-Coated Copper: ASTM B32, Grade SN 60% tin, 40% lead.
- L. Solder for Zinc: ASTM B32; 50/50 tin/lead type, with rosin flux.
- M. Self-Adhesive Flexible Sheet Flashing: 40-mil-thick composite of polyethylene film and self-adhesive rubberized asphalt with embossed slip-resistant surface; "Ice and Water Shield" by W.R. Grace or approved equal.
- N. Manufactured Reglets: Two piece pre-coated galvanized steel, spring-action type similar to "Springlock Flashing System" or approved equal, manufactured by Fry Reglet, type as indicated. Include fabricated end closures and mitered corners. Finish: Manufacturer's gray epoxy primer; exposed portions shall be field finish painted as specified in Section 09 91 00.

- O. Fabricated Galvanized Sill Pans. Shop fabricate sill pans from 24 ga, fully soldered and watertight as per the drawings. Protect underside of pans sitting atop concrete surfaces with continuous layer of self-adhered flashing.

2.3 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Fabricate concealed cleats of galvanized steel, ASTM A653, Grade 33, G90 zinc coating, 0.0478" thickness, interlockable with sheet.
- C. Fabricate exposed cleats and coverplates of same material as sheet, interlockable with sheet.
- D. Form pieces in longest practical lengths.
- E. Hem exposed edges on underside 1/2". Miter and seam corners.
- F. Form material with flat lock seam.
- G. Solder and seal metal joints. After soldering, remove flux. Wipe and wash solder joints clean.
- H. Fabricate corners from one piece with minimum 18" long legs; seam for rigidity, seal with sealant.
- I. Fabricate vertical faces with bottom edge formed outward 1/4" and hemmed to form drip.
- J. Fabricate flashings to allow toe to extend 4" over [bituminous base flashings] [roofing surface]. Return and brake edges.
- K. Fabricate vent pipe and roof penetration flashings of non lead-bearing material with clamping ring and storm collar.

2.4 FINISH

- A. Shop prepare and prime exposed ferrous metal surfaces.
- B. Back-paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.
- C. Site paint exposed to view metal surfaces under provisions of Section 09 91 00.
- D. "Kynar 500" or "Hylar 5000" factory pre-coated finish with 0.2 mil baked on primer and 0.8 mil baked on topcoat for a 1.0 mil dry film thickness. Finish shall be warrantied for a minimum of 20 years against all defects.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets are in place, and nailing strips located.
- B. Verify membrane termination and base flashings are in place, sealed, and secure.
- C. Contractor to confirm that site conditions and substrates are ready for sheet metal work to commence. If not, make suitable repairs or adjustments to the work. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Field measure site conditions prior to fabricating Work.
- B. Install starter and edge strips, and cleats before starting installation.
- C. Install surface-mounted reglets true to line and level. Seal top with sealant.
- D. Install underlayment with protective slip sheet over parapets, caps, copings, gravel stops and curbs.

3.3 INSTALLATION

- A. Conform to indicated details on the Drawings and the recommendations included in the SMACNA Architectural Sheet Metal Manual.
- B. Provide for thermal expansion of exposed sheet metal Work. Space movement joints at 10' on center maximum with no joints within 2' of corners. Attach members with clips to permit movement without damage, or provide slotted or oversize holes with washers.
- C. Form expansion joints of intermeshing hooked flanges filled with sealant.
- D. Insert flashings into reglets to form tight fit. Secure in place with lead wedges at maximum 12" on center. Pack remaining spaces with lead wool. Seal flashings into reglets with sealant.
- E. Secure flashings in place using concealed fasteners. Use exposed fasteners only where indicated.
- F. Lap, lock, seam and seal all joints. Make lock seam Work flat and true to line, and 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 3". Make seams in direction of flow.

- G. Apply plastic cement compound between metal flashings and felt flashings. Apply bituminous coating between dissimilar metals where occurs.
- H. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- I. Roof-Penetration, Vent Pipe Flashing: Turn lead flashing down inside vent piping. Clamp flashing to other pipes penetrating roof except for vent piping. Seal with elastomeric sealant.
- J. Solder metal joints watertight for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- K. Seal metal joints watertight and weathertight throughout.

3.4 FIELD QUALITY CONTROL

- A. Conform to SMACNA Architectural Sheet Metal Manual.
- B. Field observation will involve surveillance of Work during installation to ascertain compliance with specified requirements.

3.5 CLEANING AND ADJUSTMENT

- A. Leave Work clean and free of stains, scrap and debris.
- B. Repair and replace damaged Work.

END OF SECTION

SECTION 07 65 00

Flexible Flashing

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Self-adhering flexible flashing (DuPont™ FlexWrap™, DuPont™ StraightFlash™ and DuPont™ StraightFlash™ VF)
- B. Primers
- C. Fasteners (DuPont™ Tyvek® Wrap Caps)

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM C920 - Standard Specification for Elastomeric Joint Sealants
 - 2. ASTM C1193 - Standard Guide for Use of Joint Sealants
 - 3. ASTM E96 – Standard Test Method for Water Vapor Transmission of Materials
 - 4. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

1.3 SUBMITTALS

- A. Refer to Section 01 33 00 Submittal Procedures.
- B. Product Data: Submit manufacturer current technical literature for each type of product.
- C. Samples: Each type of product specified in sample 4" x 4".
- D. Quality Assurance Submittals:
 - 1. Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with indicated requirements.
 - 2. Manufacturer Instructions: Provide manufacturer's written installation instructions.

1.4 QUALITY ASSURANCE

A. Qualifications

1. Installer shall have documented successful experience with installation of flexible flashing systems under similar conditions.
2. Installation shall be in accordance with manufacturer's installation guidelines and recommendations.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01 87 00 Material and Equipment
- B. Deliver flexible flashing materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store flexible flashing materials as recommended by manufacturer. Keep away from open flame or sources of ignition.

1.6 PROJECT CONDITIONS

- A. Refer to Section 01 87 00 Material and Equipment
- B. Do not apply flexible flashing on wet or damp surfaces.
- C. Apply to surfaces free of dirt, oils, lubricants and other debris.
- D. Install flexible flashing materials at temperatures above 40°F. At temperatures below 40°F, apply primer in accordance with flashing manufacturer recommendations, prior to installation of flashing.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. DuPont Building Innovations; 4417 Lancaster Pike, Chestnut Run Plaza 721, Wilmington, DE 19805; 1-800-44-TYVEK (8-9835); <http://construction.tyvek.com> or approved equal.

2.2 MATERIALS

- A. Self-Adhering - Straight Flashing:
 1. Basis of Design: Self-adhering straight flashing membrane tape is based on DuPont™ StraightFlash™
 2. Description:

- a. Face Material Composition: Textured polyethylene laminate barrier.
 - b. Face color: White
 - c. Adhesive composition: Butyl adhesive
 - d. Thickness: 30 mil
 - e. Release Liner: 1 piece siliconized paper
 - f. Dimension: [4" wide by 150' or 9" wide by 125']
- B. Self-Adhering - Dual-Sided Straight Flashing:
- 1. Basis of Design: Dual-sided, self-adhereing straight flashing membrane tape is based on DuPont™ StraightFlash™ VF
 - 2. Description:
 - a. Face Material Composition: Spunbonded polyethylene
 - b. Face color: White
 - c. Adhesive composition: Dual-sided butyl adhesive
 - d. Thickness: 30 mil
 - e. Release Liner: 2-piece siliconized paper
 - f. Dimension: 6" wide by 125'
- C. Self-Adhering - Flexible Flashing:
- 1. Basis of Design: Self-adhering flexible flashing membrane is based on DuPont™ FlexWrap™.
 - 2. Description:
 - a. Face Material Composition: Conformable textured polyethylene laminate barrier.
 - b. Face color: White
 - c. Adhesive composition: Butyl adhesive
 - d. Thickness: 70 mil
 - e. Release Liner: 2-part siliconized paper
 - f. Elastic Elongation: > 230% at 70°F.

g. Dimension: 7" wide by 75'

D. Performance Characteristics:

1. Water intrusion: No leakage at 75 Pa, when tested in accordance with ASTM E331.
2. Water Vapor Permeability: < 1 perm, when tested in accordance with ASTM E96.

2.3 ACCESSORIES

A. Seam Tape: DuPont™ Tyvek® Tape as manufactured by DuPont Building Innovations:

1. Description: Pressure sensitive, polypropylene substrate with acrylic based adhesive.

B. Fasteners:

1. Steel Frame Construction DuPont™ Tyvek® Wrap Cap Screws as manufactured by DuPont Building Innovations: 1-5/8" rust resistant screw with 2" diameter plastic cap or manufacturer approved 1-1/4" or 2" metal gasketed washer.

C. Sealants:

1. Provide sealant that complies with ASTM C920, elastomeric polymer sealant to maintain watertight conditions.
2. Products:
 - a. Tremco, "Tremco 830", www.tremcosealants.com
 - b. Tremco, "Tremco Butyl", www.tremcosealants.com
 - c. Sealants recommended by the weather barrier manufacturer.

D. Primer:

1. Provide flashing manufacturer recommended primer to assist in adhesion between substrate and flashing
2. Products:
 - a. 3M, "Hi-Strength 90 Spray Adhesive", www.3m.com
 - b. Denso, "Butyl 7200 Spray", www.densona.com

- c. Permagrip 105
- d. Sta'-Put, "SPH (Aerosol & Canister)"
- e. Primers recommended by the flashing manufacturer

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrate and surface conditions are in accordance with flexible flashing manufacturer recommended tolerances prior to installation.
- B. Review requirements for sequencing of installation of flexible flashing assembly with installation of windows, doors, louvers and wall penetrations to provide a weather-tight flashing assembly.

3.2 OPENING PREPARATION (for use with non-flanged windows - all cladding types)

- A. Flush cut weather barrier membrane at edge of sheathing around full perimeter of opening.
- B. Cut a head flap at 45° angle in the weather barrier membrane at window head to expose 8" of sheathing. Temporarily secure weather barrier membrane flap away from sheathing with tape.

3.3 FLASHING (for use with non-flanged windows - all cladding types)

- A. Cut 7" wide DuPont™ FlexWrap™ a minimum of 12" longer than width of sill rough opening. Apply primer as required by manufacturer.
- B. Cover horizontal sill by aligning DuPont™ FlexWrap™ edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6". Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
- C. Fan DuPont™ FlexWrap™ at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges.
- D. Apply 9" wide strips of DuPont™ StraightFlash™ at jambs. Align flashing with interior edge of jamb framing. Start StraightFlash™ at head of opening and lap sill flashing down to sill.
- E. Spray-apply primer to top 6" of jambs and exposed sheathing.
- F. Install DuPont™ FlexWrap™ at opening head using same installation procedures used at sill. Overlap jamb flashing a minimum of 2".

- G. Coordinate flexible flashing with window installation.
- H. On exterior, install backer-rod in joint between window frame and flashed rough framing. Apply sealant at jambs and head, leaving sill unsealed. Apply sealants in accordance with sealant manufacturer's instructions and ASTM C1193.
- I. Position weather barrier head flap across head flashing. Adhere using 4" wide DuPont™ StraightFlash™ over the 45° seams.
- J. Tape top of window in accordance with manufacturer recommendations.
- K. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealant in accordance with sealant manufacturer's instructions and ASTM C1193.

3.4 OPENING PREPARATION (for use with flanged windows installed after weather barrier)

- A. Cut weather barrier membrane in a modified "I-cut" pattern:
 - 1. Cut weather barrier horizontally along the bottom of the header.
 - 2. Cut weather barrier vertically 2/3 of the way down from top center of window opening.
 - 3. Cut weather barrier diagonally from bottom of center vertical cut to the left and right corners of the opening.
 - 4. Fold side and bottom weather barrier flaps into window opening and fasten.
- B. Cut a head flap at 45° angle in the weather barrier membrane at window head to expose 8" of sheathing. Temporarily secure weather barrier membrane flap away from sheathing with tape.

3.5 FLASHING (for use with flanged windows installed after weather barrier)

- A. Cut 7" wide DuPont™ FlexWrap™ a minimum of 12" longer than width of sill rough opening.
- B. Cover horizontal sill by aligning DuPont™ FlexWrap™ edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6". Secure flashing tightly into corners by working in along the sill before adhering up the jambs.
- C. Fan DuPont™ FlexWrap™ at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges.

- D. On exterior, apply continuous bead of sealant to wall or backside of window mounting flange across jambs and head. Do not apply sealant across sill.
- E. Install window according to manufacturer's instructions.
- F. Apply 4" wide strips of DuPont™ StraightFlash™ at jambs overlapping entire mounting flange. Extend jamb flashing 1" above top of rough opening and below bottom edge of sill flashing.
- G. Apply 4" wide strip of DuPont™ StraightFlash™ as head flashing overlapping the mounting flange. Head flashing should extend beyond outside edges of both jamb flashings.
- H. Position weather barrier head flap across head flashing. Adhere using 4" wide DuPont™ StraightFlash™ over the 45° seams.
- I. Tape head flap in accordance with manufacturer recommendations
- J. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealant in accordance with sealant manufacturer's instructions and ASTM C1193.

3.6 FLASHING (for use with flanged windows installed before weather barrier)

- A. Attach weather barrier membrane apron under sill. Extend apron a minimum of 10" beyond sides of rough opening, and below the rough opening to overlap the sill plate or the weather barrier below. Securely attach sides of apron to wall, leaving bottom free to overlap later weather barrier installation.
- B. Cut DuPont™ FlexWrap™ a minimum of 12" longer than width of sill rough opening.
- C. Cover horizontal sill by aligning DuPont™ FlexWrap™ edge with inside edge of sill. Adhere to rough opening across sill and up jambs a minimum of 6".
- D. Fan DuPont™ FlexWrap™ at bottom corners onto face of wall. Firmly press in place. Mechanically fasten fanned edges.
- E. On exterior, apply continuous bead of sealant to wall or backside of window mounting flange across jambs and head. Do not apply sealant across sill.
- F. Coordinate with window installation.
- G. Complete flashing after installation of window/door
 - 1. Apply 4" wide strips of DuPont™ StraightFlash™ at jambs overlapping entire mounting flange. Extend jamb flashing 1" above top of rough opening and below bottom edge of sill flashing.

- H. Apply 4" wide strip of DuPont™ StraightFlash™ as head flashing overlapping the mounting flange. Head flashing should extend beyond outside edges of both jamb flashings.
- I. Position weather barrier head flap across head flashing. Adhere using 4" wide DuPont™ StraightFlash™ over the 45° seams.
- J. Tape head flap in accordance with manufacturer recommendations.
- K. On interior, install backer rod in joint between frame of window and flashed rough framing. Apply sealant around entire window to create air seal. Apply sealant in accordance with sealant manufacturer's instructions and ASTM C 1193.

3.7 FIELD QUALITY CONTROL

- A. Notify manufacturer's designated representative to obtain periodic observations of flexible flashing assembly installation.

3.8 PROTECTION

- A. Protect installed flexible flashing from damage during construction.

END OF SECTION

SECTION 08 13 13

Hollow Metal Doors and Frames

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Related Sections:
 - 1. Section 09 91 00 Painting; for field painting hollow metal doors and frames.
- B. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI/SDI A250.3 – Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames
 - 2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Anchors.
 - 3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
 - 4. ANSI/SDI A250.8 - Standard Steel Doors and Frames.
 - 5. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
 - 6. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
 - 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 A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable.

10. ASTM E90 – Standard Test Method for Laboratory Measurement of AirBorne Sound Transmission Loss of Building Partitions and Elements
11. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
12. ANSI/BHMA A156.15 - Closer Holder, Electromagnetic and Electromechanical.
13. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
14. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
15. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
16. SDI-117 - Manufacturing Tolerances Standard Steel Doors and Frames.
17. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
18. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
19. California Building Code and amendments.

1.3 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" high wood blocking. Do not store in a manner that traps excess humidity.
 1. Provide minimum 1/4" space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.4 PROJECT CONDITIONS

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

1.5 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.6 WARRANTY

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CECO Door Products., www.cecodoor.com
 - 2. Curries Company., www.curries.com
 - 3. Security Metal Products.
 - 4. Steelcraft., www.steelcraft.com

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/ A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A653/ A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- C. Frame Anchors: ASTM A653/ A653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 STANDARD 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

A1008/ A1008M.

1. Fabricate frames with mitered or coped corners.
 2. Fabricate frames with "closed and tight" miter seams continuously welded on face, finished smooth with no visible seam unless otherwise indicated.
 3. Frames for Level 2 Steel Doors: Minimum 16 gauge (0.053" - 1.3-mm) thick steel sheet.
 4. Frames for Level 3 Steel Doors (up to 48" in width): Minimum 16 gauge (0.053" - 1.3-mm) thick steel sheet.]
 5. Frames for Level 3 Steel Doors (48" and up in width): Minimum 14 gauge (0.067" - 1.7-mm) thick steel sheet.]
 6. Frames for Wood Doors: Minimum 16 gauge (0.053" - 1.3-mm) thick steel sheet.
 7. Frames for Borrowed Lights: Minimum 16 gauge (0.053" - 1.3-mm) thick steel sheet.
 8. Manufacturers Basis of Design:
 - a. CECO Door Products BQ/BU/DQ/DU Series (Drywall Profile).
 - b. CECO Door Products SQ/SU/SR/ Series (Masonry Profile).
 - c. Curries Company C/CM/CG Series (Drywall Profile).
 - d. Curries Company M/G Series (Masonry Profile).
- 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.

2.4 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" thick, with corrugated or perforated straps not less than 2" wide by 10" long; or wire anchors not less than 0.177" thick.
 2. Stud Wall Type: Designed to engage stud and not less than 0.042" thick.

3. Windstorm Opening Anchors: Types as tested and required for indicated wall types to meet specified wind load design criteria.
 4. FEMA 361 Storm Shelter Anchors: Masonry T-shaped, wire masonry type, or existing opening type anchors.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042" thick.
- C. Mortar Guards: Formed from same material as frames, not less than 0.016" thick.

2.5 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for 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 Frames:
1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
 3. 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.
 4. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
 5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 6. Jamb Anchors: Provide number and spacing of anchors as follows:

- a. Masonry Type: Locate anchors not more than 18" from top and bottom of frame. Space anchors not more than 32" o.c. and as follows:
 1. Two anchors per jamb up to 60" high.
 2. Three anchors per jamb from 60" to 90" high.
 3. Four anchors per jamb from 90" to 120" high.
 4. Four anchors per jamb plus 1 additional anchor per jamb for each 24" or fraction thereof above 120" high.
- b. Stud Wall Type: Locate anchors not more than 18" from top and bottom of frame. Space anchors not more than 32" o.c. and as follows:
 1. Three anchors per jamb up to 60" high.
 2. Four anchors per jamb from 60" to 90" high.
 3. Five anchors per jamb from 90" to 96" high.
 4. Five anchors per jamb plus 1 additional anchor per jamb for each 24" or fraction thereof above 96" high.
 5. Two anchors per head for frames above 42" wide and mounted in metal stud partitions.
7. 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".
- D. 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 71 00 "Door Hardware."
 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.6 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.
- B. Factory Pre-Finished: Factory apply electrostatic paint finish to doors and frames in accordance with ANSI/SDI A250.3 test procedure acceptance criteria for steel doors and frames with factory applied finished coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness.
- C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.
 - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 - 3. 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.

3.4 ADJUSTING AND CLEANING

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

END OF SECTION

SECTION 08 14 16

Flush Wood Doors

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wood doors, fire-rated and non-rated.
- B. Door louvers.

1.2 REFERENCES

- A. WDMA Architectural Door Standards
- B. NFPA 80 - Fire Doors and Windows.
- C. CBC - California Building Code.
- D. UL 10C - Fire Tests of Door Assemblies.
- E. WI - Woodwork Institute: Manual of Millwork.

1.3 QUALITY ASSURANCE

- A. Conform to requirements of WI Manual of Millwork, Section 12 and 13, Premium Grade except where otherwise indicated.
- B. Issue a WI Certified Compliance Certificate prior to delivery of doors certifying that doors meet all requirements of WI Grade specified.
- C. After completion issue a WI Certified Compliance Certificate for Installation.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings shall bear the WI Certified Compliance Label on the first page of each set. Indicate door elevations, stile and rail reinforcement, internal blocking for hardware attachment, and cutouts for glazing and louvers.
- C. Submit two Samples 12" x 12" in size illustrating each species and finish specified.

1.5 DELIVERY, STORAGE, AND PROTECTION

- A. Protect products under provisions of Section 01 87 00.

- B. Package, deliver, and store doors in accordance with WI requirements as set forth in Technical Bulletin 419-R.

1.6 WARRANTY

- A. Provide manufacturer's standard lifetime warranty under provisions of Section 01 77 00 for solid core doors.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS, FLUSH FACED DOORS and FRAMES

- A. Eggers Industries, Inc., www.vtindustries.com
- B. Marshfield Door Systems, Inc., architectural.masonite.com
- C. Algoma Hardwoods, Inc.
- D. Frames: Anemostat or equal., anemostat.com
- E. Substitutions: Under provisions of Section 01 62 00.

2.2 DOOR AND FRAME CONSTRUCTION

- A. Solid Non-rated Core: Solid wood block, framed block glued, or solid particleboard.
- B. Construction: 5-ply, with face veneer applied vertically over wood veneer cross banding.
- C. Flush Interior Door Veneer: Birch for paint grade. Satin sheen. Color as selected by Architect to match other doors on site.

2.3 ADHESIVES

- A. Exterior and Interior Doors: WI Type I.

2.4 FABRICATION

- A. Fabricate non-rated wood doors to requirements of WI Manual of Millwork, Section 12 and 13, in the WI Grade specified.
- B. Premachine doors for finish hardware.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install doors in accordance with WI Manual of Millwork Sections 12 and 13 and WI Technical Bulletin 420-R.
- B. Conform to WI requirements for fit tolerances.
- C. Coordinate installation of glass and glazing.
- D. Install door louvers.
- E. Adjust doors for smooth and balanced movements.

3.2 INSTALLATION TOLERANCES

- A. Edge clearance for swinging doors shall not exceed the following:
 - 1. Between door and frame at head and jamb 1/8"
 - 2. Between edge of pair of doors 1/8"
 - 3. At door sill with threshold 3/8"
 - 4. At door bottom and surface of nominal floor covering per NFPA 80 and at doors requiring an undercut as indicated on Drawings. 5/8"
- B. Frame installation tolerance shall not exceed the following:
 - 1. Squareness $\pm 1/16"$
 - 2. Alignment $\pm 1/16"$
 - 3. Plumbness $\pm 1/16"$
 - 4. Diagonal Distortion $\pm 1/32"$

END OF SECTION

SECTION 08 91 00

Metal Wall Louvers

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Louvers and frames.
- B. Bird screening.

1.2 REFERENCES

- A. ANSI/AMCA 500 - (Air Movement Council Association) Laboratory Method of Testing Louvers for Rating.
- B. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot- Dip Process.
- C. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot- Dip Process.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.3 SYSTEM PERFORMANCE

- A. Fabricate louver to permit 57% free area.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacture of AMCA certified louvers with five years experience.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Provide Product Data on preassembled louvers describing design characteristics, maximum recommended air velocity, free area, materials, and finishes.
- C. Submit manufacturer's installation instructions.

1.6 COORDINATION

- A. Coordinate Work of this Section with installation of flashings under Section 07 62 00 and furnace enclosures under Section 23 54 16.13.

- B. Coordinate Work of this Section with the mechanical system. Refer to the mechanical drawings for additional information.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Airline Louvers Co., www.airlinelouvers.com
- B. The Construction Specialties Group., www.c-sgroup.com
- C. The Airolite Co., www.airolite.com (as a standard of quality).
- D. Industrial Louvers, Inc., www.industriallouvers.com
- E. Substitutions: Under provisions of Section 01 62 00.

2.2 MATERIALS

- A. Aluminum:, 6063 alloy, T5 or T52 temper; extruded shape.
- B. Steel Sheet: ASTM A653, Commercial Steel, Type A, galvanized to G90 zinc coating in accordance with ASTM A924.
- C. Fasteners and Anchors: Stainless steel type.

2.3 ACCESSORIES

- A. Bird Screen: Interwoven wire mesh of aluminum, 0.063" diameter wire, 1/2" open weave, diagonal design.
- B. Flashings: Of same material as louver frame.

2.4 FABRICATION

- A. Drainable blade, Fixed Louvers: Airolite, Model K6746.
- B. Louver Size: 6" deep, face measurements as indicated.
- C. Louver Blade: Sloped at 37°, minimum material thickness of 12 gauge.
- D. Louver Frame: Channel shape, mechanically fastened corner joints, material thickness of 12 gauge.
- E. Head, Jamb, and Sill Flashings: Roll formed to required shape, one piece per location.

- F. Screens: Permanently install screen mesh in shaped frame with reinforced corner construction; screw to louver frame.

2.5 FINISHES

- A. Aluminum Surfaces: AA-M12C22A42 clear anodized

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that prepared openings [and flashings] are ready to receive Work and opening dimensions are as indicated on Drawings.
- B. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Secure louvers in opening framing with concealed fasteners.
- D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- E. Install bird screening to exterior of louver under metal protection grille.

3.3 CLEANING

- A. Clean surfaces and components.

END OF SECTION

SECTION 09 29 00

Gypsum Board

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Gypsum board.
- B. Taped and sanded joint treatment.
- C. Surface primer.
- D. Texture finish.
- E. Level 5 finish, if indicated.
- F. Resilient furring channels.
- G. Metal channel ceiling framing.

1.2 REFERENCES

- A. ASTM C11 - Standard Terminology Relating to Gypsum and Related Building Materials and Systems.
- B. ASTM C475 – Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- C. ASTM C514 – Standard Specification for Nails for the Application of Gypsum Wallboard.
- D. ASTM C557 – Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
- E. ASTM C641 – Standard Test Method for Iron Staining Materials in Lightweight Concrete Aggregates.
- F. ASTM C645 – Standard Specification for Nonstructural Steel Framing Members.
- G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
- I. ASTM C919 – Standard Practice for Use of Sealants in Acoustical Applications.

- J. ASTM C1002 - 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.
- K. ASTM C1396 - Standard Specification for Gypsum Board.
- L. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- M. ASTM E90 – Standard Test Method for Laboratory Measurement of Airborne Sound transmission Loss of Building Partitions and Elements.
- N. GA-214-2015 – Recommended Levels of Finish Gypsum Board ,Glass Mat & Fiber-Reinforced Gypsum Panels
- O. GA-216 - Application and Finishing of Gypsum Panel Products.
- P. GA-600 - Fire Resistance and Sound Control Design Manual.
- Q. CBC - California Building Code.
- R. UL - Underwriters Laboratories.

1.3 QUALITY ASSURANCE

- A. Applicator: Company specializing in gypsum board systems, with five years documented experience.

1.4 REGULATORY REQUIREMENTS

- A. Conform to CBC, Chapter 7, and UL and GA requirements for fire-rated assemblies.

1.5 ACOUSTICAL PERFORMANCE

- A. Acoustical attenuation for interior partitions, where indicated, shall be STC rating in accordance with ASTM E90.

1.6 DEFINITIONS

- A. Refer to ASTM C11 for definitions of terms related to gypsum board assemblies.

1.7 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Provide Product Data for all items specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Georgia Pacific Corp., www.gp.com
- B. National Gypsum Company., www.nationalgypsum.com
- C. United States Gypsum Co., www.usg.com
- D. Substitutions: Under provisions of Section 01 62 00.

2.2 FRAMING MATERIALS

- A. Furring Channel: ASTM C754, 1-1/2" x .475 lbs. per foot.
- B. Fasteners: ASTM C514 and ASTM C1002.
- C. Adhesive: ASTM C557.

2.3 GYPSUM BOARD MATERIALS

- A. Standard Gypsum Board: ASTM C1396; 5/8" thick unless otherwise indicated, maximum permissible length; ends square cut, tapered and beveled edges.
- B. Fire Rated Gypsum Board: ASTM C1396; fire resistive type, UL rated; 5/8" thick unless otherwise indicated, maximum permissible length; ends square cut, tapered and beveled edges.

2.4 ACCESSORIES

- A. Acoustical Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.
 - 1. "Sheetrock® Brand Acoustical Sealant", manufactured by United States Gypsum Company.
 - 2. "BA-98 Acoustical Sealant", manufactured by Pecora Corporation.
 - 3. "Tremco Acoustical Sealant", manufactured by Tremco, Inc.
- B. Corner Beads: Metal, hot dip galvanized.
- C. Edge Trim: GA 216; Type LC bead, unless otherwise indicated.
- D. Control Joints: Roll-formed zinc, USG No. 093, or approved equal.
- E. Spot Grout: ASTM C475, setting-type joint compound.

- F. Joint Materials: ASTM C475; reinforcing tape, joint compound, adhesive, water, and fasteners. Use tapes and compound recommended by gypsum board manufacturer for the use intended. Use ready mixed, drying type compounds. Use taping compound for embedding tape and first coat over fasteners and flanges of corner beads and trim. Use topping compound for fill and finish coats.
- G. Primer: Flat latex basecoat paint equivalent to "First Coat" manufactured by United States Gypsum Company.
- H. Textures: To match existing.
- I. Membrane: ASTM D226; No. 15 asphalt saturated roofing felt.
- J. Adhesive for Application Over Hard Surfaces: Mastic glue as recommended by the gypsum board manufacturer for the specific substrate.

PART 3 - EXECUTION

3.1 INSPECTION

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

3.2 MEMBRANE INSTALLATION

- A. Install membrane over wall studding where moisture resistant gypsum board is to be installed.
- B. Install membrane over substrate; weatherlap horizontal edges 4", vertical edges 6".

3.3 GYPSUM BOARD INSTALLATION

- A. Install gypsum board in accordance with ASTM C840 and manufacturer's instructions.
- B. Erect single layer standard gypsum board in most economical direction, with ends and edges occurring over firm bearing except those ends and edges which are perpendicular to framing.
- C. Erect single layer fire rated gypsum board vertically, with edges and ends occurring over firm bearing except those ends and edges which are perpendicular to framing members. Comply with required UL, CBC, or GA fire rated assembly.

- D. Erect double layer gypsum board with standard gypsum board for first layer placed in most economical direction with second layer placed parallel to face layer with adhesive and supplementary fasteners. Off-set joints of second layer from joints of first layer by at least 12".
- E. Erect double layer fire-rated gypsum board in accordance with required UL, CBC, or GA fire rated assembly.
- F. Use screws when fastening gypsum board to metal furring.
- G. Use screws when fastening gypsum board to wood furring or framing except where nails are required for UL or CBC fire-rated assembly.
- H. Install firestop sealant at wall penetrations and terminations in accordance with required UL, CBC, or GA fire-rated assembly in accordance with Section 07 84 00.
- I. Treat cut edges and holes in moisture-resistant gypsum board with sealant.
- J. Place control joints as indicated on the Drawings.
- K. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.
- L. Spot grout metal door frames. Apply spot grout at each jamb anchor clip just before inserting board into frame.

3.4 EXTERIOR SOFFIT AND CEILING INSTALLATION

- A. Apply gypsum soffit board panels perpendicular to supports with end joints staggered and located over supports.
- B. Install panels with 1/4" space where panels abut other construction penetrations.
- C. Fasten with corrosion-resistant screws.

3.5 JOINT TREATMENT

- A. Tape, fill, and sand joints, edges, and corners in accordance with GA 214.
- B. Feather successive coats a minimum of 2" onto adjoining surfaces for each coat.
- C. Where fire-resistance rating is required, detail of joint treatment shall meet fire-rating requirement.
- D. Level 1 Treatment:
 - 1. All joints and angles shall have tape embedded in joint compound.

2. Surface shall be free of excess joint compound.
3. Tool marks and ridges are acceptable.
4. Use for plenum areas above ceiling, in areas that are generally concealed and other areas not normally open to view.

E. Level 2 Treatment:

1. All joints and angles shall have tape embedded in joint compound and one separate coat of joint compound shall be applied over all fastener heads and accessories.
2. Surface shall be free of excess joint compound.
3. Tool marks and ridges are acceptable.
4. Use where surface is substrate to ceramic tile, acoustic tile, or tackable wallboard system.

F. Level 3 Treatment:

1. Not used.

G. Level 4 Treatment:

1. All joints and angles shall have tape embedded in joint compound with three separate coats of topping compound applied over all joints, angles, fasteners, and accessories.
2. All compound shall be smooth and free of tool marks and ridges.
3. Sand lightly between coats, taking care not to roughen face paper.
4. Use for all surfaces that are scheduled to receive a textured and painted finish, except areas of food service and preparation, or a surface applied wallcovering.
5. Where patching skip-trowel, knock-down or other finishes, match existing to the greatest extent possible.

H. Level 5 Treatment:

1. All joints and angles shall have tape embedded in joint compound with three separate coats of topping compound applied over all joints, fasteners, and accessories.
2. Apply a thin skim coat of topping compound over entire surface.
3. All compounds shall be smooth and free of tool marks and ridges.

4. Sand lightly between coats.

3.6 FINISHING

- A. Roller apply surface primer to all gypsum board surfaces scheduled to receive a painted and textured finish prior to application of paint or texture finish.
- B. Spray apply textured finish to all surfaces scheduled to receive a paint finish except surfaces of food service and preparation areas.
- C. Trowel-apply patch-to-match textures to match existing.
- D. Remove any overspray of texture finish from door frames, windows, and other adjoining construction.

3.7 TOLERANCES

- A. Maximum Variation from True Flatness: 1/8" in 10' in any direction.

3.8 SCHEDULE

- A. Existing Construction: Patch-to-match, or if exceeds 30% of existing wall, strip and replace to the nearest surface break and treat this area as new construction.

<u>Room Type</u>	<u>Wallboard System</u>	<u>Finish Type</u>	<u>Notes</u>
Typical Surfaces (Classrooms, corridors, office/work areas)	5/8", Type X	Match existing	

END OF SECTION

SECTION 09 91 00 Painting

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Products and application.
- C. Surface finish schedule.
- D. Patch to match existing.

1.2 REFERENCES

- A. ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
- B. ASTM D2016 - Test Method for Moisture Content of Wood.

1.3 SYSTEM DESCRIPTION

- A. Preparation of all surfaces to receive final finish.
- B. Painting and finishing Work of this Section using coating systems of materials including primers, sealers, fillers, and other applied materials whether used as prime, intermediate, or finish coats.
- C. Surface preparation, priming, and finish coats specified in this Section are in addition to shop-priming and surface treatment specified under other Sections.
- D. Painting and finishing all exterior and interior surfaces of materials including structural, mechanical, and electrical Work on site, in building spaces, and above or on the roof.
- E. Paint exposed surfaces except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces.

1.4 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this Section.

1.5 QUALITY ASSURANCE

- A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with five years experience.
- B. Applicator: Company specializing in commercial painting and finishing with five years documented experience.
- C. 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. Comply with the current applicable regulations of the California Air Resources Board (CARB) and the Environmental Protection Agency (EPA).
- D. Coats: The number of coats specified is the minimum number acceptable. If full coverage is not obtained with the specified number of coats, apply such additional coats as are necessary to produce the required finish.
- E. Employ coats and undercoats for all types of finishes in strict accordance with the recommendations of the paint manufacturer.
- F. Provide primers and undercoat paint produced by the same manufacturer as the finish coat.

1.6 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Provide manufacturer's technical information and instructions for application of each material proposed for use by catalog number.
- C. List each material by catalog number and cross-reference specific coating with specified finish system.
- D. Provide manufacturer's certification that products proposed meet or exceed specified materials.
- E. Submit two 8-1/2" x 11" Samples of each paint color and texture applied to cardboard. Resubmit Samples until acceptable color, sheen and texture is obtained.

1.7 FIELD SAMPLES

- A. Provide field samples under provisions of Section 01 33 00.
- B. On wall surfaces and other exterior and interior components, duplicate specified finishes on at least 100 square feet of surface area.
- C. Provide full-coat finishes until required coverage, sheen, color and texture are

obtained.

- D. Simulate finished lighting conditions for review of field samples.
- E. After finishes are accepted, the accepted surface may remain as part of the Work and will be used to evaluate subsequent coating systems applications of a similar nature.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver the products to site and store and protect under provisions of Section 01 87 00.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptance.
- C. Container labeling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing. Paint containers not displaying product identification will not be acceptable.
- D. Store paint materials at minimum ambient temperature of 45°F and a maximum of 90°F, in well ventilated area, unless required otherwise by manufacturer's instructions.
- E. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45°F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is above 50%, unless required otherwise by manufacturer's instructions.
- C. Minimum Application Temperatures for Latex Paints: 45°F for interiors; 50°F for exterior; unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperature for Varnish and Urethane Finishes: 65°F for interior or exterior, unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 foot-candles measured mid-height at substrate surface.

1.10 EXTRA STOCK

- A. Provide a ten gallon container of each finish paint color to District for touchup.
- B. Label each container with color, texture, and room locations in addition to the manufacturer's label.

1.11 QUALITY ASSURANCE

- A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with five years experience.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, other manufacturers offering equivalent products are:
 - 1. Benjamin Moore Paints, (213) 722-3484.
 - 2. Frazee Paint (McCloskey, Ameron), (213) 727-2861.
 - 3. Kelly-Moore Paint Company, (650) 592-8337.
 - 4. Pittsburgh Paints, (888) 774-2001.
 - 5. Sherwin Williams, (310) 404-7422.
 - 6. Spectra-Tone Paint Corp., (909) 478-3485.
 - 7. Tnemec Company, Inc., (310) 643-5191.
 - 8. Vista Paint Corporation, (714) 680-3800.

2.2 MATERIALS

- A. Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.
- B. Good flow and brushing properties; capable of drying or curing free of streaks or sags.
- C. Accessory Materials: Linseed oil, shella, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

2.3 FINISHES

- A. Refer to schedule at end of Section for surface finish schedule.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that surfaces are ready to receive Work as instructed by the product manufacturer.
- B. Examine surfaces to be finished prior to commencement of Work. Report any condition that may potentially affect proper application.
- C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Plaster and Gypsum Wallboard: 12%.
 - 2. Masonry, Concrete, and Concrete Unit Masonry: 12%.
 - 3. Exterior Located Wood: 15%, measured in accordance with ASTM D2016.
- D. Beginning of installation means acceptance of existing surfaces.

3.2 SURFACE PREPARATION

- A. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.
- B. Correct minor defects and clean surfaces which affect Work of this Section.
- C. Shellac and seal marks which may bleed through surface finishes.
- D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- E. Aluminum Surfaces: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- F. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- G. Gypsum Board: Repair all voids, nicks, cracks and dents with patching materials and finish flush with adjacent surface. Latex fill minor defects. Spot prime defects after repair.
- H. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Pretreat with phosphoric acid etch or vinyl wash. Apply coat of etching primer the same day as pretreatment is applied.

- I. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- J. Uncoated Steel and Iron: Remove grease, scale, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- K. Shop Primed Steel: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- L. Interior Wood: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- M. Exterior Wood: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied.

3.3 PROTECTION OF ADJACENT WORK

- A. Protect elements surrounding the Work of this Section from damage or disfiguration.
- B. Repair damage to other surfaces caused by Work of this Section.
- C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
- D. Remove empty paint containers from site.

3.4 WORK NOT TO BE PAINTED

- A. Painting is not required on surfaces in concealed and inaccessible areas such as furred spaces, foundation spaces, utility tunnels, pipe spaces and duct shafts.
- B. Do not paint metal surfaces such as stainless steel, chromium plate, brass, bronze, and similar finished metal surfaces.
- C. Do not paint anodized aluminum or other surfaces which are specified to be factory pre-finished.
- D. Do not paint sandblasted or architecturally finished concrete surfaces.
- E. Do not paint over Underwriters Laboratories, Factory Mutual or other code-required labels or identifications.

3.5 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish.
- D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- E. Sand lightly between coats to achieve required finish.
- F. Allow applied coat to dry before next coat is applied.
- G. 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.
- H. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- I. Prime back surfaces of interior and exterior woodwork with primer paint.
- J. Cloudiness, spotting, lap marks, brush marks, runs, sags, spikes and other surface imperfections will not be acceptable.
- K. Where spray application is used, apply each coat of the required thickness. Do not double back to build up film thickness of two coats in one pass.
- L. Where roller application is used, roll and redistribute paint to an even and fine texture. Leave no evidence of roller laps, irregularity of texture, skid marks, or other surface imperfections.
- M. For painting of exterior patchwork, paint to the nearest surface break.

3.6 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Paint shop primed equipment. Do not paint shop prefinished items.
- B. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- C. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are prefinished.
- D. Replace identification markings on mechanical or electrical equipment when painted accidentally.

- E. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
- F. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.
- G. Paint grilles, registers, and diffusers which do not match color of adjacent surface.
- H. Paint all mechanical and electrical equipment, vents, fans, and the like occurring on roof.
- I. Do not paint moving parts of operating units; mechanical or electrical parts such as valve operators; linkages; sensing devices; and motor shafts.
- J. Do not paint over labels or equipment identification markings.
- K. Do not paint mechanical room specialties such as compressors, boilers, pumps, control panels, etc.
- L. Do not paint switch plates, light fixtures, and fixture lenses.

3.7 CLEANING

- A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.
- B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
- C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.8 PROTECTION OF COMPLETED WORK

- A. Protect finished installation under provisions of Section 01 87 00.
- B. Erect barriers and post warning signs. Maintain in place until coatings are fully dry.
- C. Confirm that no dust generating activities will occur following application of coatings.

3.9 PATCHING

- A. After completion of painting in any one room or area, repair surfaces damaged by other trades.
- B. Touch-up or re-finish as required to produce intended appearance.

3.10 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 45 29.
- B. The District reserves the right to invoke the following test procedure at any time and as often as the District deems necessary.
- C. The District will engage the services of an independent testing agency to sample paint material being used.
- D. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.
- E. The testing agency will perform appropriate quantitative materials analysis and other characteristic testing of materials as required by the District.
- F. If test results show materials being used and their installation do not comply with specified requirements or manufacturer's recommendations, the Contractor may be directed to stop painting, remove noncomplying paint, pay for testing and repaint surfaces to acceptable condition.

3.11 COLOR SCHEDULE

- A. Paint and finish colors shall be custom color, mixed and formulated to match existing finishes.
- B. Access doors, registers, exposed piping, electrical conduit and mechanical/electrical panels if not stainless steel; generally the same color as adjacent walls.
- C. Exterior and interior steel doors, frames and trim; match adjacent existing door frames.
- D. Doors: Match adjacent existing door paint or varnish.
- E. Interior and Exterior Steel Fabrications, if not Stainless Steel: Match existing or adjacent walls.

3.12 SCHEDULE - EXTERIOR SURFACES

- A. The following paint systems shall be used:
 - 1. Wood-Painted (Flat Acrylic) - Exterior Trim and Exposed Wood Framing
 - 1st coat: EZSL00 EZ-PRIME Select
 - 2nd coat: EVSH10 Evershield
 - 3rd coat: EVSH10 Evershield
 - 2. Wood-Painted (Semi-Gloss Acrylic)

- | | |
|-----------|------------------------|
| 1st coat: | EZSL00 EZ-PRIME Select |
| 2nd coat: | EVSH50 Evershield |
| 3rd coat: | EVSH50 Evershield |
3. Wood-Painted (Gloss Alkyd)
- | | |
|-----------|------------------------|
| 1st coat: | EZSL00 EZ-PRIME Select |
| 2nd coat: | ASHL70 ARISTOSHIELD |
| 3rd coat: | ASHL70 ARISTOSHIELD |
4. Wood - Semi-Transparent
- | | |
|-----------|------------------------|
| 1st coat: | WPT3 "OKON Weatherpro" |
|-----------|------------------------|
5. Cement Plaster (Flat Acrylic)
- | | |
|-----------|-------------------|
| 1st coat: | ESPR00Eff-Stop |
| 2nd coat: | EVSH10 Evershield |
| 3rd coat: | EVSH10 Evershield |
6. Cement Plaster (Flat Elastomeric)
- | | |
|-----------|------------------------|
| 1st coat: | ESPR00Eff-Stop |
| 2nd coat: | EDLX10 ENDURALASTIC 10 |
| 3rd coat: | EDLX10 ENDURALASTIC 10 |
7. Steel-Primed or Unprimed (Flat Acrylic)
- | | |
|-----------|--------------------|
| 1st coat: | ENPR00 ENDURAPRIME |
| 2nd coat: | EVSH10 Evershield |
| 3rd coat: | EVSH10 Evershield |
8. Steel-Primed or Unprimed (Semi-Gloss Acrylic)
- | | |
|-----------|--------------------|
| 1st coat: | ENPR00 ENDURAPRIME |
| 2nd coat: | EVSH50 Evershield |
| 3rd coat: | EVSH50 Evershield |
9. Steel-Primed or Unprimed (Gloss-Alkyd)
- | | |
|-----------|---------------------|
| 1st coat: | BRPR00 BLOC-RUST |
| 2nd coat: | ASHL70 ARISTOSHIELD |
| 3rd coat: | ASHL70 ARISTOSHIELD |
10. Steel-Galvanized (Flat Acrylic)
- | | |
|-----------|-------------------------------------|
| 1st coat: | Krud Kutter Metal Clean and Etch |
| 2nd coat: | ULGM00 ULTRASHIELD Galvanized Metal |
| 3rd coat: | EVSH10 Evershield |
| 4th coat: | EVSH10 Evershield |
11. Steel-Galvanized (Semi-Gloss - Acrylic)
- | | |
|-----------|----------------------------------|
| 1st coat: | Krud Kutter Metal Clean and Etch |
| 2nd coat: | ULTRASHIELD Galvanized Metal |
| 3rd coat: | EVSH50 Evershield |

4th coat EVSH50 Evershield

12. Steel-Galvanized (Gloss - Alkyd)

1st coat: Krud Kutter Metal Clean and Etch
2nd coat: ULTRASHIELD Galvanized Metal
3rd coat: ASHL70 ARISTOSHIELD
4th coat: ASHL70 ARISTOSHIELD

3.13 SCHEDULE - INTERIOR SURFACES

A. The following paint systems shall be used:

1. Steel - Primed or Unprimed (Semi-Gloss-Alkyd) - Steel Doors/Frames

1st coat: BRPR00 BLOC-RUST (or touch up)
2nd coat: ASHL50 ARISTOSHIELD
3rd coat: ASHL50 ARISTOSHIELD

2. Gypsum Board (Eggshell-Acrylic) - Gypsum Board Walls and Ceilings

1st coat: VNPR00 VINYLASTIC
2nd coat: SPMA30 SUPREMA
3rd coat: SPMA30 SUPREMA

3. Gypsum Board (Semi-Gloss -Acrylic) - Wipe down areas

1st coat: VNPR00 VINYLASTIC
2nd coat: EVSH50 Evershield
3rd coat: EVSH50 Evershield

END OF SECTION

SECTION 23 00 00
Heating, Ventilation, and Air Conditioning

GENERAL

1.1 DESCRIPTION

- A. Work under this section includes all labor, equipment, material, services, transportation, etc.
 - 1. required for and reasonably incidental to the complete and satisfactory installation of all of the HVAC Systems as indicated on the Drawings or specified herein.

1.2 Work included in This Section:

- A. Diffusers, Registers, and Grilles.
- B. Duct Insulation.
- C. Piping Insulation.
- D. Vibration Isolation.
- E. Ductwork and Accessories.
- F. Refrigerant Piping.
- G. Test and Balance.
- H. Submittals and Shop Drawings.
- I. Record Drawings.
- J. Operation and Maintenance Manuals.
- K. Guarantee.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Electrical supply to units. See Electrical documentation.
- B. Section 23 09 22 Climate Management Control for HVAC.
- C. Section 23 81 26 Split System Air Conditioners.

- D. Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment.
- E. Section 23 54 16.13 Gas-Fired Furnaces
- F. Section 23 05 53 Identification for HVAC Piping and Equipment.

1.4 GENERAL REQUIREMENTS

- A. This section of the specification shall be considered as a part of the entire specification and all applicable portions of General Conditions, Special Conditions, and Division 1 shall apply.
- B. Before commencement of work this contractor shall determine the exact location, size, elevation, and availability of all utilities relevant to the mechanical work and immediately notify the owner with written notification of any discrepancies. In addition, this Contractor shall contact all involved utility companies, make all necessary arrangements for service, and pay all fees incurred due to connection of services.
- C. Erection: The Contractor shall furnish the services of an experienced superintendent, who shall be constantly in charge of the erection of the work, together with all necessary journeymen, helpers, and laborers required to properly unload, erect, connect, adjust, start of operate and test the work involved.

1.5 REFERENCES

- A. AABC - National Standards for Field Measurement and Instrumentation, Total System Balance.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 300 - Test code for sound rating air-moving devices.
- D. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation System.
- E. ARI 270 - Sound rating of Outdoor Unitary Equipment.
- F. ASHRAE 52-76 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- G. ASTM A90 - Weight of Coating on Zinc - Coated (Galvanized) Iron or Steel Articles.
- H. ASTM A120 - Black and Galvanized Steel Pipe.

- I. ASTM B88 - Seamless Copper Water Tube.
- J. ASTM C518 - Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- K. ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
- L. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
- M. ASTM E84 - Surface Burning Characteristics of Building Materials.
- N. ASTM E96 - Water vapor Transmission of Materials.
- O. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
- P. NFPA 255 - Surface Burning Characteristics of Building Materials.
- Q. SMACNA - Low Pressure Duct Construction Standards.
- R. UL 181 - Factory Made Air Ducts and Connectors.
- S. UL 723 - Surface Burning Characteristics of Building Materials.
- T. California Mechanical Code – 2022 Edition.

1.6 SUBMITTALS AND SHOP DRAWINGS

- A. Contractor agrees that shop drawings submittals processed by the owner do not become Contract Documents and are not Change Orders; that the purpose of the shop drawing review is to establish a reporting procedure and is intended for the Contractor's convenience in organizing his work and to permit the owner to monitor the Contractor's progress and understanding of the design. The process of review of the Contractor's submittals is not of testing the owner's perception. If deviations, discrepancies or conflicts between shop drawings submittals and the Contract Documents are discovered either prior to or after the shop drawing submittals are processed by the owner, the Contractor agrees that the Contract Documents shall control and shall be followed.
- B. Prepare and furnish fully coordinated shop drawings showing ductwork and piping on separate drawings. The drawings shall be minimum 1/4" = 1'-0" scale and shall show dimensioning of piping and ductwork from gridlines, bottom of elevation marks for ductwork and piping and fittings, valves, dampers, devices, etc. with labels. In addition, coordinate with related work and reference on the same drawings major plumbing piping, structural steel, fire protection piping, conduit runs and cable trays. Review and sign these drawings to verify coordination of related equipment. Conflicts, which occur shall be brought to

the attention of the owner prior to issuance of the drawings. Refer to Section 01330 of the Specifications for additional requirements.

- C. Contractor shall provide detailed shop drawings min. 45 days prior to installation for a complete functional system indicating all equipment, ductwork routing, and etc. including changes in elevation, direction, sway bracing, and etc. Contractor shall indicate all roof curb, concrete pads, and/or platform locations and sizes.
- D. Materials and Equipment: As soon as possible and within 21 days after award of the contract, and before their purchase, the Contractor shall submit to the owner seven bound booklets for approval containing a complete list of materials, specialties and equipment he is to furnish for the installation. Literature shall be standard manufacturer's catalog cuts and items to be installed shall be clearly indicated. All submittals shall be made at one time.
- E. Each item shall be identified by manufacturer, brand and trade name, number, size, rating and whatever other data is necessary to properly identify and check the materials and equipment. The words: "as specified" will not be considered sufficient identification.
- F. Accessories, controls, finish, etc., not submitted or identified with the submitted equipment shall be furnished and installed as specified.
- G. Shop drawings shall be approved only to extent of information indicated. Approval of an item of equipment shall not be construed to mean approval for components for that item for which Contractor has provided no information.
- H. Approval of shop drawings shall not relieve Contractor of responsibility for providing all controls, wiring, components, etc. which are shown or specified, or all additional controls, wiring, components, etc. required to provide complete and correctly operating mechanical systems.
- I. Submit product data for the following manufactured products, assemblies, personnel and testing agencies required for this project.
 - 1. Diffusers, Registers, and Grilles.
 - 2. Ductwork and Accessories.
 - 3. Duct Insulation.
 - 4. Piping Insulation.
 - 5. Vibration Isolation.

6. Test and Balance - Detailed procedures, agenda, sample report forms, and copy of AABC National Project Performance Guarantee.

7. Refrigerant Piping.

1.7 SUBSTITUTIONS

- A. Should the Contractor desire to substitute any material, equipment or other items for those specified, he shall submit a complete list, including detailed equipment layouts and performance characteristics within 35 calendar days after the scheduled Start of Construction. Said data shall be submitted in 7 copies, assembled in individual brochures.
- B. The entire cost of all changes of any type due to substitution for materials specified shall be born by the Contractor at no extra cost to the owner.
- C. Unsolicited and voluntary deducts, on the part of the Contractor for substituting unapproved systems and/or equipment, shall not be considered for the purpose of awarding the Contract.
- D. The contractor shall submit the amount of cost credit to the Contract in the event the proposed substitution is accepted.
- E. In all cases where substitutions are proposed after bids are received, the Contractor shall bear the cost of evaluation on the basis of 2-1/2 times technical salaries of engineering personnel involved.

1.8 AVAILABILITY OF SPECIFIED EQUIPMENT

- A. Verify prior to bidding that all specified equipment is available and can be obtained in time for installation during orderly and timely progress of the work.
- B. In the event that specified items will not be so available, notify the owner prior to receipt of bids.
- C. Costs of delays because of non-availability of specified items, when such delays could have been avoided by proper investigation on the part of the Contractor, will be back-charged as necessary and shall not be born by the owner.

1.9 RECORD DRAWINGS

- A. The contractor shall arrange and pay for one set of white prints of the HVAC drawings, which he shall alter in red to show all changes made to the original layout. These drawings shall be kept current.
- B. The contractor shall deliver these completed to the owner when the job is

finished and accepted prior to final payment.

1.10 OPERATION AND MAINTENANCE DATA

- A. Submit two sets prior to final inspection, bound in 8-1/2 x 11 inch text pages, binders with durable plastic covers. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", and title of project. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- B. Contents: Prepare a Table of Contents with each Product or system description identified.
 - 1. Part 1: Directory listing names, addresses, and telephone numbers of owner, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by system. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
- C. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with owner comments. Revise content of documents as required prior to final submittal.
- D. Submit final volumes (revised) within ten days after final inspection.

1.11 GUARANTEES

- A. The Contractor, in accepting this contract, binds himself to replace or repair at his own expense any defect in workmanship or material which may appear within a period of one year from the date of the final acceptance of the building, and to pay for all resulting damage which shall appear within the said period;

provided always that the Contractor shall not be liable for anything attributable to acts of the agents of the owner, or for ordinary wear. Also, given date of work performed by the Contractor be accepted as complete, he shall agree to correct any deficiencies or omissions in respect to the plans or specifications which may appear in the afore-mentioned twenty-four month period.

- B. The Contractor guarantees that all piping as provided in this specification will be free from all obstructions, and that all piping will be tight and drip free.
- C. All refrigerant compressors shall carry a five-year manufacturer's warranty.

1.12 LOCAL CONDITIONS

- A. The Contractor and trade submitting tenders on this work shall visit and will be deemed to have visited the site to ensure that they are familiar with all conditions relating to the work. Failure to visit the site will in no way relieve the successful Contractor of the necessity of furnishing any material or performing any work that may be required to complete the work in accordance with the drawings and specifications without additional cost to the owner.

1.13 RULES, REGULATIONS AND CODES

- A. All work and materials shall be in full accordance with the latest California Mechanical Code, California Plumbing Code, California Building Code and local rules and regulations, State Fire Marshal regulations, the safety orders of the Division of Industrial Safety; the National Electric Code; the standards of the National Fire Protection Association; American Gas Association; Occupation and Safety Act; American National Standards Institute; American Society of Mechanical Engineers; American Society for Testing and Materials; Installation Standards published by the International Association of Plumbing And Mechanical officials (IAPMO) and other applicable laws, codes, or regulations. Nothing in these specifications shall be construed to permit work not conforming to these codes.
- B. Electrical Work: Motors, electrical apparatus and wiring specified in this section shall conform to the National Electrical Manufacturer's Standards and the National Electric Code and bear the Underwriter's label of approval.
- C. The Contractor shall furnish, without extra charge, any additional material and labor when and where required to comply with these rules and regulations, though the work be not mentioned in these Specifications or shown on the Drawings. When these Specifications or Drawings call for or describe materials or construction of a better quality or larger sizes than required by the above-mentioned rules and regulations, the provisions of these specifications and accompanying drawings shall take precedence.

1.14 FEES AND PERMITS

- A. The Contractor must obtain and pay all fees for permits, licenses, inspections, etc., which are required by any legally constituted authority. Coordinate exact requirements with the owner prior to bid.

1.15 COORDINATION

- A. Following the general arrangement indicated on the Drawings as closely as possible, the Contractor shall coordinate with the architectural, structural, plumbing, electrical and all other trades prior to installation of the materials and equipment to verify adequate space available for installation of the work shown. The owner shall be immediately notified if an area of conflict occurs between trades.
- B. The Contractor shall bear all costs incurred for work that must be relocated due to conflicts between trades.
- C. The Mechanical Contractor shall coordinate all requirements for all points of connection with the General Contractor and other trades prior to bid.

1.16 DRAWINGS

- A. The work shall be installed as indicated on Drawings, however, changes to accommodate installation of this work with other work, or in order to meet Architectural or structural conditions, shall be made without additional cost to the owner.
- B. For the purpose of clarity and legibility, the Drawings are essentially diagrammatic to the extent that many offsets, bonds, unions, special fittings and exact locations are not indicated. The Contractor shall make use of all data in all of the Contract Documents, and shall verify this information at the site.

1.17 INSPECTION

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.18 DELIVERY, STORAGE AND PROTECTION OF PROPERTY

- A. Place orders for all equipment in time to prevent any delay in construction

schedule or completion of project. If any materials or equipment are not ordered in time, additional charges made by equipment manufacturers to complete their equipment in time to meet construction schedule, together with any special handling charges, shall be borne by the contractor.

- B. Materials shall be delivered in ample quantities from time to time as may be necessary for the uninterrupted progress of the work. They shall be stored as to cause the least obstruction to the premises and distributed so as to prevent overloading to any portion of the structure.
- C. The Contractor shall provide temporary storage and shop areas that are required at the site for the safe and proper storage of materials, tools, and other items used in the performance of this work. These areas shall be constructed only in approved locations and shall not interfere with the work of any other Contractor.
- D. All work, equipment and materials shall be protected at all times. The Contractor shall make good all damage caused either directly or indirectly by his own workmen. The Contractor shall also protect his own work from damage. He shall close all pipe and duct openings with caps or plugs during installation. He shall protect all of his equipment and materials against dirt, water, chemical, and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

1.19 DAMAGE BY LEAKS, ETC.

- A. The Contractor shall be responsible for all damage to any part of the premises or work of other Contractors, caused by leaks or breaks in the piping or equipment furnished and/or installed under this section, during the construction and guarantee period.

1.20 ACCESS TO EQUIPMENT FOR MAINTENANCE

- A. Install all equipment, ductwork, piping, etc. to permit access for normal maintenance. Maintain easy access to filters, motors, etc. Install all such equipment and accessories to facilitate maintenance. Perform any relocation of pipes, etc. required to permit access at request of owner at no additional cost to owner.
- B. Furnish and install access doors or panels in walls, floors, and ceilings to permit access to equipment, dampers, and all other items requiring service. Coordinate location of access doors with other trades as required.
- C. Size access panels to allow inspection and removal of all items served.

- D. Use Milcor style as required for material in which door is installed. Where door is installed in fire rated construction, provide door bearing UL label required for condition.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials and equipment shall be new and of the best of their respective grades, free from all defects and of the make, brand or quality herein specified or as accepted by the owner.
- B. All materials and equipment shall be identified by manufacturer's name or nameplate data.
 - 1. Unidentified material or equipment shall be removed from the site.
- C. Equipment specified by manufacturer's number shall include all accessories, controls, etc., listed in the catalog as standard with the equipment. Optional or additional accessories shall be furnished as specified.
- D. Where no specific make of material or equipment is mentioned, any first class product of a reputable manufacturer may be used, provided it conforms to the requirements of the system and meets with the approval of the owner.
- E. Equipment and materials damaged during transportation, installation and operation shall be considered as "totally damaged" and shall be replaced with new. Any variance from this clause shall be made only with written approval of the owner.

2.2 MANUFACTURER

- A. Diffusers, Registers, and Grilles:
 - 1. Krueger.
 - 2. Titus.
 - 3. Price.
- B. Vibration Isolation:
 - 1. M.W. Sausse.
 - 2. Mason.

3. Approved Equal.

C. Piping Insulation

1. Aeroflex USA, Inc.; Aeroseal.
2. Armacell LLC; Armaflex 520 Adhesive.
3. Approved Equal

2.3 DUCTWORK AND ACCESSORIES

- A. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.
- B. Steel Ducts: ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz per sq. ft. for each side in conformance with ASTM A90. Round duct shall be spiral seam construction.
- C. Spiral Ducts: Interlocking spiral of galvanized steel or aluminum construction; rated to (2 inches WG positive and 1.5 inches WG negative for low pressure ducts) (and 15 inches WG positive or negative for medium high pressure ducts.)
- D. Fasteners: Rivets, bolts, or sheet metal screws.
- D. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.
- E. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
- F. Low Pressure Ducts:
 1. Fabricate and support in accordance with 2016 CMC, SMACNA Low Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Gages for galvanized steel ducts for low pressure systems where velocities do not exceed 2000 FPM shall be as follows:

RECTANGULAR DUCT		ROUND DUCT	
Dimension of Largest Side (L) in Inches	Gage	Diameter (D) in Inches	Ga.

$L \leq 12$	26	$D < 9$	26
$12 \leq L \leq 30$	24	$9 \leq D < 14$	24
$30 < L \leq 54$	22	$14 \leq D < 23$	22
$54 < L \leq 84$	20	$23 \leq D < 37$	20
$84 < L$	18	$37 \leq D < 51$	18
		$51 \leq D < 61$	16
		$61 \leq D < 84$	14

2. All joint and seam constructions as indicated in the CMC are acceptable.
3. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.
4. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide turning vanes.
5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
6. Use double nuts and lock washers on threaded rod supports.

G.

H. Volume Control Dampers:

1. Fabricate in accordance with SMACNA Low Pressure Duct Construction

Standards, and as indicated.

2. Opposed blade dampers shall have factory-fabricated blades, with factory assembled linkages, mounted in frames. Blades shall have interlocking edges and ends. Rectangular dampers 6" or more wide, shall be the multi-blade type. Blades on multi-blade type dampers must not be over 6" wide. Dampers shall be of the opposed blade type. Dampers shall have bar or channel frames and corner bracing. All blade and linkage bearings shall be self lubricating plastic. Damper assembly leakage not to exceed 1% with 4.0 W.C. static pressure.
 3. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 4. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
- I. Duct Test Holes:
1. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.4 REFRIGERANT PIPING

- A. Insulation and covering on all pipe and tubing shall have flame spread rating not to exceed 25 and a smoke density not to exceed 50 when tested in accordance with CMC.
- B. Refrigeration Piping: Type 'L' hard temper copper tubing with wrought copper fittings, silver brazed, suitable for 400 psi working pressure.

2.5 DIFFUSERS, REGISTERS, AND GRILLES:

- A. Fabricate of steel with steel or aluminum frame and baked enamel off-white finish.
- B. Air inlets and outlets: See equipment schedule.
- C. Accessories: See equipment schedule.

2.6 CONTROLS

- A. The Mechanical Contractor shall be responsible for the proper coordination of all control work and electrical work in connection therewith. He shall also be responsible for the proper operation of the entire system.

- B. The Electrical Contractor shall furnish and install all line voltage control wiring, and in all conduit. Wire sizing and length of run shall be coordinated with the manufacturer and Electrical Engineer. The Mechanical Contractor shall furnish and install all low voltage control wiring, and in conduit.
- C. Electrical Work: All electric relays, hand-off automatic switches and all electrical wiring and all conduit will be provided under the Electrical Section, except as otherwise specified. Furnish and install additional conduit, wiring, relays, hand-off automatic switches made necessary by the use of approved substituted equipment under this Section with no additional cost to the owner.
- D. Refer to drawings for control diagrams and additional requirements.
- E. Calibration of Controls: The Mechanical Contractor shall carefully calibrate and adjust all controls as required to maintain comfort conditions and maximum energy conservation.

2.7 INSULATION

A. General:

- 1. All insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation) fire smoke hazard ratings as tested by procedure ASTM E84, and UL 723 not exceeding:
 - a. Installed Indoors: Flame Spread: 25 and Smoke Developed: 50
 - b. Installed Outdoors: Flame Spread: 75 and Smoke Developed: 150
- 2. All products or their shipping cartons shall bear a label indicating that flame and smoke ratings do not exceed above requirements. Any treatment of jackets or facings to impart flame and smoke safety shall meet the above requirements.
- 3. The Contractor shall certify that all products used have met the above criteria.
- 4. The insulation values shown are a minimum. If the requirements of Title 24 exceed these values, the amount of and/or type must be increased to meet the Title 24 requirements.

B. Piping Insulation:

- 1. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

Thickness: 1 inch.

2. Insulate refrigerant piping
3. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
4. Field applied Jackets for piping installed outdoors: comply with ASTM C 921, Type I, unless otherwise indicated.
 - a. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
 - b. Metal Jacket and Fitting Covers: Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

C. Duct Insulation:

1. Fiberglass Duct Wrap:
 - a. Insulation: ASTM C553; flexible, noncombustible blanket.
 1. 'K' value: ASTM C518, 0.48 at 75 degrees F.
 2. Maximum service temperature: 250 degrees F.
 3. Density: 0.75 lb/ ft³.
 - b. Vapor Barrier Jacket:
 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film vinyl.
 2. Moisture vapor transmission: ASTM E96; 0.5 perm.
 3. Secure with pressure sensitive tape.
 - c. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
 - d. Tile Wire: Annealed steel, 16 gage.
2. Glass Fiber Duct Liner, Rigid:
 - a. Insulation : ASTM C612; semi-rigid, noncombustible.

1. 'K' value: ASTM C518, 0.24 at 75 degrees F.
 2. Maximum service temperature: 250 degrees F.
 3. Density: 1.5 to 3.0 lb/cu ft.
 4. Maximum Velocity on Coated Air Side: 4,000.
- b. Adhesive: Waterproof (fire-retardant) type.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install all equipment in locations indicated on the Drawings. Contractor will be responsible to verify with the owner, if suitability is doubted. Contractor shall notify the owner before installation into any apparent improper locations of interference with other work such as electrical outlets, windows, cabinetwork or other features.

3.2 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 3. Install insulation to flanges as specified for flange insulation application.
 4. Secure insulation to valves and specialties and seal seams with

manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.3 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.
- B. Ductwork and Accessories:
 - 1. 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.
 - 2. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
 - 3. Provide balancing dampers at points on low-pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Use splitter dampers only where indicated.
 - 4. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
 - 5. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 12x 12 inch size for hand access, 30 x 30 inch size for shoulder access, and as indicated.
 - 6. Provide duct test holes where indicated and required for testing and balancing purposes.
 - 7. Check location of outlets and inlets and make necessary adjustments in position to conform to Architectural features, symmetry, and lighting arrangement.
 - 8. Install diffusers to ductwork with airtight connection.
 - 9. Provide balancing dampers on duct take-off to diffusers and registers, regardless of whether dampers are specified as part of the diffuser, or

register assembly.

10. Paint ductwork visible behind air outlets and inlets matte black.

C. Thermostats and over-ride switches: Install at 48" above finished floor unless otherwise stated. Coordinate with other trades. Contractor shall be responsible for verifying, furnishing all controls and wiring for thermostats and shall coordinate all requirements with other trades including notifying electrical contractor of necessary conduit and power requirements. All costs for scope of work shall be submitted for final bid.

D. Insulation:

1. Duct Insulation:

a. Unless specifically indicated on the drawings the Contractor may line or wrap ductwork to meet insulation requirements.

b. Fiberglass duct wrap:

1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples, tape, or wires.
3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

c. Duct (and Plenum) liner Application:

1. Install as indicated (sound lining) on the drawings.
2. Adhere insulation with adhesive for 100 percent coverage. Secure insulation with mechanical liner fasteners. Refer to SMACNA Standards for spacing. Seal and smooth joints. Seal liner surface penetrations with adhesive.
3. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

3.4 CLEANING:

- A. Clean new and existing duct systems before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.

7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

F. Submit report for district review and approval with before and after photos

3.5 AIR SYSTEM TEST AND BALANCE

- A. Perform all tests to the entire satisfaction of the owner. Air balancing contractor shall notify owner one week prior to scheduling air balance at the site.
- B. Regulating and Adjusting Air Systems:
 1. The Contractor shall have an experienced independent testing company certified member of the Associated Air Balance Council (A.A.B.C.) specializing in air conditioning system testing completely balance the air systems so that the volume of air indicated on the drawings is being delivered to the outlets. He shall adjust and re-adjust this part of the work

until the operation complies with the requirements of the drawings and specifications.

2. Testing Procedure: Procedures shall conform to A.A.B.C. standards. Provide reports in sort cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
3. The following test data shall be taken and three (3) copies submitted in tabulated form to the Architect for each system:
 - a. Test and adjust all supply, return & exhaust blower RPM to design requirements.
 - b. Test and record all motor full load amperes.
 - c. Test and record system static pressures, suction and discharge.
 - d. Test and adjust system for design re-circulated air, CFM.
 - e. Test and adjust system for design CFM outside air.
 - f. Adjust all supply and return outlets to within 5% of design CFM.

3.6 SOUND AND VIBRATION ISOLATION

- A. All vibrating equipment shall be sound isolated from the structure.
- B. The Contractor shall submit all necessary data for each elastomeric isolation pads, including weight loading, for equipment in operation.
- C. See mechanical drawings for additional information.

3.7 JOB COMPLETION

- A. Final Operation: Upon completion of the installation of the equipment and after all systems have been tested, cleaned, the Contractor shall place a competent person in charge who shall operate the equipment for a period of three eight-hour days. During this period of operation, all safety and operating controls shall be actuated to demonstrate proper operation. During this operating period, the Owner's representative shall be instructed in all details of operation and maintenance. All required instructions from the equipment manufacturer's representative shall be given during the period.
- B. Operation Instructions:

1. Prepare a diagram of the entire control system with a full description of the heating, ventilating and air conditioning systems.
2. After approval by the Engineer, the control diagram and complete operating instructions shall be mounted under glass and installed where directed.
3. Prepare two (2) maintenance manuals which shall include all the necessary or pertinent data, such as:
 - a. Names, addresses and emergency phone numbers of all suppliers and manufacturers.
 - b. Part numbers of all replaceable items.
 - c. Oiling and lubrication instructions.
 - d. Air balance report.
 - e. Control diagram and operation sequence, together with labeling of controls and instruments to match the diagram.
 - f. A maintenance schedule which shall list all required maintenance on all equipment furnished under this section of the specifications and the intervals of which the items are to be performed.

C. Clean-Up:

1. After all heating, ventilating and air conditioning work has been tested and approved, the Contractor shall thoroughly clean all parts of the equipment installation. Exposed parts which are to be painted are to be thoroughly cleaned of cement plaster and other materials and all greases and oil spots removed with solvent. Exposed rough metal work to be carefully brushed down with steel brushes to remove rust and other spots and left in proper condition to receive painter's finish.
2. Remove all debris from the job site, all cartons, boxes, packing crates, excess materials not used to occasion by the work and to the satisfaction of the Owner.
3. If the above requirements of clean-up are not to the satisfaction of the Owner, the Owner reserves the right to order the work done and the cost of which shall be borne by the Contractor.
4. The Contractor shall remove on a daily basis all debris from the job site, to the satisfaction of the Owner.

5. If the above requirements of clean-up are not to the satisfaction of the Owner, the Owner reserves the right to order the work done by a third party and the cost of which shall be borne by the Contractor.

END OF SECTION 23 00 00

SECTION 23 05 53
Identification for HVAC Piping and Equipment

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, with predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2 1/2 by 3/4 inch (64 by 19 mm).
 - 6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing

distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. Fasteners: Stainless-steel self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

END OF SECTION 23 05 53

SECTION 23 09 23
DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish a native BACnet Energy Management System (EMS) as specified herein. The operator's workstation, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135-2016, BACnet. In other words, all workstations and controllers, including unitary controllers, shall be native BACnet devices. No gateways shall be used for communication to controllers installed under this section. Gateways may be used for communication to existing systems or to systems installed under other sections.
- B. The native BACnet EMS shall be as specified herein and consist of a high-speed, peer-to-peer local area network of DDC controllers connected to a dedicated Server PC and other client workstation PC's and Lap Top computers as specified. All HVAC and/or Electrical system points monitored and controlled by the EMS, including the building floor plans as well as all control devices, will be depicted by point-and-click graphics.
- C. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windowsbased control software and every controller in system, including unitary controllers. All controller devices must be BTL tested and listed by the official BACnet Testing Laboratory, having the BTL approval mark issued with Rev 15 or later listing for the MS/TP devices.
- D. Operator's Workstation is existing. Control contractor shall update graphic display to depict new HVAC equipment per mechanical drawings control diagram.
- E. All devices in this new project facility location shall be accessible from a single graphical user interface.
- F. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
- G. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
- H. Furnish and install the required software to produce a complete and operational native BACnet EMS as specified herein.

- I. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
- J. Provide a comprehensive operator and technician training program as described herein.
- K. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
- L. Products Installed but Not Supplied Under This Section: None.
- M. Work Required Under Other Divisions Related to This Section:
 - 1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
 - 2. Provision and wiring of smoke detectors and devices relating to fire alarm system.
 - 3. Campus LAN (Ethernet) connection adjacent to Operator Workstation.

1.2 SPECIFICATION NOMENCLATURE AND DEFINITIONS

- A. Acronyms Used in this Specification:
 - 1. Actuator: Device that opens or closes valve or damper in response to control signal.
 - 2. Analog: Continuously variable state overstated range of values.
 - 3. AWS: Advance Workstation
 - 4. BAS: Building Automation System.
 - 5. Compass: Alerton Workstation Software.
 - 6. DDC: Direct Digital Control.
 - 7. HVAC: Heating, Ventilating and Air Conditioning.
 - 8. LAN: Local Area Network.
 - 9. Modulating: Movement of control device through a range of values, proportional to an infinitely variable input value.
 - 10. Motorized: Control device with actuator.

11. Operator Workstation: PC running Compass software and any required software tools applicable for day to day operation of the BMS.
12. PICS: BACnet Product Interoperability Compliance Statement.
13. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
14. Point: Analog or discrete instrument with addressable database value.
15. WAN: Wide Area Network.

1.3 SYSTEM DESCRIPTION

- A. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135-2016, BACnet and achieved listing under the BACnet Testing Laboratories BACnet - Advanced Workstation Software (B-AWS). This system is to control all mechanical equipment, including all unitary equipment such as heat pumps, fan-coils, AC units, etc., and all air handlers, boilers, cooling towers, and any other listed equipment using native BACnet-compliant components. Non-BACnet-compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited.

1.4 APPROVED MANUFACTURERS

- A. Basis of Design Control Manufacturers:
 1. Alerton – Ascent Compass; no substitution by at Syserco.
- B. Owner and Owner's Representative reserves the right to approve and/or deny qualification status of all potential bidders based upon references and compliance with Specifications and Contract Documents.

1.5 QUALITY ASSURANCE

- A. The Contractor shall be regularly engaged in the manufacturing, installation and maintenance of EMS systems and shall have demonstrated technical expertise and experience in the manufacture, installation and maintenance of EMS systems similar in size and complexity to this project.
- B. The EMS system shall be designed, installed, commissioned, and serviced by manufacturer authorized and trained personnel. System provider shall have an in-place support facility within 50 miles of the site with technical staff, spare parts

inventory and necessary test and diagnostic equipment.

- C. To provide the level of support and response required by the Owner, the Energy Management System Contractor shall have a fully staffed service. 24/7 Service Call Center staffed by live operators enabling immediate response to Owner's critical emergency EMS concerns.
- D. EMS Contractor shall have a proven record of successful native BACnet installations and maintenance of equivalent native BACnet systems for a minimum period of 5 years utilizing the same native BACnet manufacturer's product line that the Contractor proposes to use on this project.
- E. Materials and equipment shall be manufacturer's latest standard design that complies with the specification requirements.
- F. All BAS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX.
- G. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store and handle in strict compliance with manufacturer's written instruction and recommendations.
- B. Protect from damage due to weather, excessive temperature and construction operations.

1.7 REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
 - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - 2. ANSI/ASHRAE Standard 135-2016, BACnet.
 - 3. Uniform Building Code (UBC), including local amendments.
 - 4. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
 - 5. National Electrical Code (NEC).

6. FCC Part 15, Subpart J, Class A.
 7. EMC Directive 89/336/EEC (European CE Mark).
 8. UL-864 UUKL listing for Smoke Controls for any equipment used in smoke control sequences.
- B. City, county, state, and federal regulations and codes in effect as of contract date.
- C. Except as otherwise indicated, the system supplier shall secure and pay for all permits, inspections, and certifications required for his work, and arrange for necessary approvals by the governing authorities.

1.8 SUBMITTALS

A. Drawings

1. The system supplier shall submit engineered drawings, control sequence, and bill of materials for approval.
2. Drawings shall be submitted in the following standard sizes: 11" x 17" (ANSI B).
3. Eight (8) complete sets (copies) of submittal drawings shall be provided.
4. Drawings shall be available on CD-ROM.

B. System Documentation

Include the following in submittal package:

1. System configuration diagrams in simplified block format.
2. All input/output object listings and an alarm point summary listing.
3. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
4. Complete bill of materials, valve schedule and damper schedule.
5. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
6. Overall system operation and maintenance instructions—including preventive maintenance and troubleshooting instructions.
7. For all system elements—operator's workstation(s), building controller(s),

application controllers, routers, and repeaters—provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2016.

8. Provide complete description and documentation of any proprietary (non-BACnet) services and/or objects used in the system.
9. A list of all functions available and a sample of function block programming that shall be part of delivered system.

1.9 WARRANTY

- A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from completion of system acceptance.
- B. Extended Warranty – Years 2 to 5. For Characterized Control Valves (CCV), Globe Valves, Butterfly Valves, associated Valve Actuators and Damper Actuators, provide like kind replacement components for any defective material identified and returned in Years 2 to 5 from the date of production.
- C. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor.
- D. This warranty shall apply equally to both hardware and software.

1.10 RELATED WORK IN OTHER SECTIONS

- A. Refer to Division 0 and Division 1 for related contractual requirements.
- B. Refer to Section 23 00 00 for General Mechanical Provisions.
- C. Refer to Section 26 00 00 for General Electrical Provisions.

PART 2 - PRODUCTS

2.1 EXISTING ADVANCED WORKSTATION

- A. General structure of workstation interaction shall be a standard client/server relationship. Server shall be used to archive data and store system database for the BACnet network as specified in these contract document Specifications and project Plan Drawings. Thick and Web Clients shall access server for all archived data. Server shall support a minimum of 20 simultaneous clients.
- B. BACnet Conformance
 1. Operator workstation shall be approved by the BTL as meeting the BACnet

Advanced Workstation (AWS) requirements.

2. Please refer to Section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
3. Standard BACnet object types accessed by the workstation shall include as a minimum: Analog Value, Analog Input, Analog Output, Binary Value, Binary Input, Binary Output, Calendar, Device, Event Enrollment, File, Notification Class, Program, and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
4. The AWS shall comply with Annex J of the BACnet specification for IP connections. Must support remote connection to server using a thick client application. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs). Workstation shall support Foreign Device Registration to allow temporary workstation connection to IP network.

C. Data Displays

1. Data displays shall render all data associated with project as called out on drawings and/or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings and wiring diagrams from as-built drawings.
2. Data displays shall render all data using iconic graphic representations of all mechanical equipment. System shall be capable of displaying graphic file, text, and dynamic object data together on each display and shall include animation. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units. All information on any display shall be dynamically updated without any action by the user.
3. Data display frame shall allow user to change all field-resident AWS functions associated with the project, such as setpoints, weekly schedules, exception schedules, etc., from any screen, no matter if that screen shows all

text or a complete graphic display. This shall be done without any reference to object addresses or other numeric/mnemonic indications.

4. Analog objects shall be displayed with operator modifiable units. Analog input objects may also be displayed as individual graphic items on the display screen as an overlay to the system graphic.
5. All displays and programming shall be generated and customized by the local EMS Contractor. Systems requiring factory development of graphics or programming of DDC logic are specifically prohibited.
6. AWS shall be supplied with a library of standard graphics, which may be used unaltered or modified by the operator. AWS shall include a library of equipment graphic components to assemble custom graphics. Systems that do not allow customization or creation of new graphic objects by the operator (or with third-party software) shall not be allowed.
7. Data display frame shall include customizable and persistent tree navigation for building, equipment and system diagnostic centric display organization.
8. Each display may be protected from viewing unless operator credentials have the appropriate access level. An access level may be assigned to each display and system object. The menu label shall not appear on the graphic if the operator does not have the appropriate security level.
9. Data displays shall have the ability to link to content outside of the BAS system. Such content shall include but is not limited to: Launching external files in their native applications (for example, a Microsoft Word document) and launching a Web browser resolving to a specified Web address.
10. Data displays shall support:
 - a. Graphic items with custom geometry that offer both color gradient shading and variable opacity in scale to system variables and range set points.
 - b. Clear and custom geometry navigation buttons to provide intuitive navigation.
 - c. Graphic files in jpg, png, and .gif file types.
 - d. Viewing of 1,024 system data points in a single screen.
11. All graphical user interface screens developed for Thick or Web Client devices on this project shall be seamlessly integrated to the existing Alerton Ascent Compass Server PC by the EMS Contractor. Graphical user interface screens for this project requiring software enabling/support beyond

Alerton Ascent Compass are specifically prohibited.

D. Password Protection

1. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator's assigned functions when user is logged on. This includes displays as outlined above.
2. AWS shall provide security for a minimum of 200 users. Each user shall have an individual User ID, User Name, and Password. Entries are alphanumeric characters only and are case sensitive (except for User ID). User ID shall be 0–8 characters, User Name shall be 0–29 characters, and Password shall be 4–8 characters long.
3. Each user shall be allowed individual assignment of only those control functions, menu items, and user specific system start display, as well restricted access to *discrete BACnet devices* to which that user requires access.
4. All passwords, user names, and access assignments shall be adjustable online at the operator's terminal.
5. Users shall also have a set access level, which defines access to displays and individual objects the user may control. System shall include 10 separate and distinct access levels for assignment to users.
6. System shall include an Auto Logout Feature that shall automatically logout user when there has been no keyboard or mouse activity for a set period of time. Time period shall be adjustable by system administrator. Auto Logout may be enabled and disabled by system administrator. Operator terminal shall display message on screen that user is logged out after Auto Logout occurs.
7. The system shall permit the assignment of an effective date range, as well as an effective time of day, that the User IDs are permitted to authenticate.

E. Operator Activity Log

1. Operator Activity Log that tracks all operator changes and activities shall be included with AWS. System shall track what is changed in the system, who performed this change, date and time of system activity, and value of the change before and after operator activity. Operator shall be able to display all activity, sort the changes by user and also by operation. Operator shall be able to print the Operator Activity log display.

2. Log shall be gathered and archived to hard drive on AWS as needed. Operator shall be able to export data for display and sorting in a spreadsheet.
3. User option to enter a comment in Operator Activity Log upon system point change. Option to enforce user comment in order to complete system point change.
4. Operator Activity Log is accessible via right mouse click and selection from web client context menu.

F. Scheduling

1. AWS and Web Client shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays and daily, with events being the highest.
2. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.
3. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate access privileges.
4. AWS shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting Schedule.
5. Scheduling shall include optimum start based on outside air temperature, current heating/cooling setpoints, indoor temperature and history of previous starts. Each and every individual zone shall have optimum start time independently calculated based on all parameters listed. User shall input schedules to set time that occupied setpoint is to be attained. Optimum start feature shall calculate the startup time needed to match zone temperature to setpoint. User shall be able to set a limit for the maximum startup time allowed.
6. Schedule list shall show all schedules currently defined. This list shall include all standard, holiday and event schedules. In addition, user shall be able to select a list that shows all scheduled points and zones.
7. Display of all three schedules must show all ON times for standard, holiday and event schedules in different colors on a given day. In addition, OFF

times for each must also be shown in additional colors. User shall be able to select from standard calendar what days are to be scheduled and same display shall show all points and zones affected. User shall be able to set time for one day and select all days of the week that shall be affected as a recurrence of that same schedule for that given day.

8. Any displayed data that is changeable by the operator may be selected using the right mouse button and the schedule shall then be selectable on the screen. Selection of the schedule using this method shall allow the viewing of the assigned schedule allow the point to be scheduled.
9. Schedule editor shall support Drag-n-drop events and holidays onto the schedule calendar.
10. Schedule editor shall support Drag-n-drop events default to a 2hr period; which can then be adjusted by the user.
11. Schedule editor shall support Drag-n-drop holidays are defaulted for OFF all day and can be edited for multiple-day holidays.
12. Schedule editor shall support the View of affected zones when adding or editing timed events of a schedule.

G. Advanced Scheduling:

1. Hierarchy of schedulable resources shall be customized to meet owner/operator specific scheduling needs and requirements.
2. Schedulable resources shall support analog and binary data points, e.g. AV, AO, BV, BO objects.
3. Each schedulable resource shall have its own unique schedule object.
4. Holiday schedules shall support definition of a specific date or a perpetual holiday with a duration, for example the USA Thanksgiving two-day holiday.
5. Calendar events set to be reoccurring events shall support the following recurrence patterns:
 1. Repeat daily every x days or every weekday
 2. Repeat weekly every x weeks on selected days of the week
 3. Repeat monthly every x months on a specific date of the month or a specific day such third Saturday or last Monday.
 4. Repeat yearly every x years on a specific month and date or a

specified day of a specified month, e.g. last Wednesday of November

6. Calendar events set to be reoccurring events shall support the following recurrence ranges: no end date, end after x occurrences, and end by a specified date.
7. Calendar events set to be reoccurring events shall support a custom recurrence setting that is a collection of specified random dates that may have no logical pattern.
8. Calendar events shall be configurable as a template that allows quick reuse and application by drag-and-drop onto any resource calendar. Any event shall be capable of being made into an event template.
9. Calendar events shall require the following parameters: Event Name, Event Type (binary or setpoint), Start Date/Time, and End Date/Time.
 - a. Analog Event Type shall support selecting setpoint type to ensure that only compatible analog points are scheduled with a specified value
10. Calendar Events shall support selection of schedulable resources by inheritance to all child resources or by selection of specific resources. Each selected resource shall support setting a start and end offset of +/- 6 hours from event start/end times.
11. The following conflict resolution rules shall be provided to determine what to do when schedulable resources have two events scheduled for the same time: Local vs. Inherited event; On vs. Off event; Newest vs. oldest event.

H. Alarm Management

1. AOWS shall provide visual, printed, and email means of alarm indication. Printout of alarms shall be sent to the assigned network printer. Alarm notification can be filtered based on the User ID's authorization level.
2. Alarm Manager shall provide log of alarm messages. History of alarm occurrences shall be archived to the data storage of the AOWS or a SQL data base. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment, identification of operator acknowledging alarm, a comment from the operator who acknowledged the alarm, and the number of alarm occurrences.

3. Alarm Manager shall provide a means to filter all alarms that have been configured in the system for alarm description, current alarm state, default and customer date range, disabled/enabled, and priority level.
4. Alarm Manager shall provide a means to disable alarms for the purpose of performing maintenance without creating concern with unneeded alarm notifications.
5. Alarm messages shall be in user-definable text (English or other specified language) and shall be delivered either to the AOWS user interface or through remote communication using email (Authenticated SMTP supported).
6. Alarm Manager shall provide the permissioned ability to Clear alarm occurrences from the Alarm Manager table while retaining the alarm in the AOWS database for reporting purposes.
7. Alarm Manager shall provide the permissioned ability to Purge alarm occurrences from the both the Alarm Manager table and the AOWS database.
8. Alarm Manager shall provide a user customizable navigation link from the Alarm message to the data display or template to the equipment associated with the alarm.
9. Alarm Manager shall provide a context menu that will allow for navigation to Schedule, Trendlog, Object Property display, or System (user) Activity from the Alarm points live data value.
10. AOWS shall include an Alarm Wizard for set up of alarms. Wizard shall walk user through all steps necessary for alarm generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting alarm setup.
11. User can silence audible annunciation for the current session.
12. User can disable auto-refresh of alarm annunciation for current session.
13. Any displayed data that is changeable by the operator may be selected using the right mouse button and the alarm shall then be selectable on the screen. Selection of the alarm using this method shall allow the viewing of the alarm history or allow the creation of a new alarm.
14. Alarm Priority Levels (0-127) shall be definable in number and name. Alarms can be assigned to any of the priority levels defined.
15. The following Alarm data shall be displayed in the Alarm Management User

Interface for each alarm:

- a. Number of times the alarm has occurred
- b. Average alarm duration (hours, minutes, and seconds) for the following transitions:
 - 1. Active to Normal
 - 2. Active to Acknowledgement
 - 3. Acknowledgement to Normal
- c. Actual alarm duration (hours, minutes, and seconds) for the following transitions for each alarm occurrence:
 - 1. Active to Normal
 - 2. Active to Acknowledgement
 - 3. Acknowledgement to Normal
- 2. Live data point of point alarmed
- 3. Navigation link to a user-selected display or URL

16. User Comment text shall be entered upon acknowledgement of an Alarm. The comment history is stored in the system data base and a user cannot edit or delete a comment after it has been submitted in the system.

17. Alarm Performance: An alarm annunciation shall appear on the AOWS user interface within 8 seconds and appear in the Alarm manager and data base within 10 seconds of a triggered alarm.

I. Trend log Information

1. AWS shall periodically gather historically recorded data stored in the building controllers and store the information in the system database. Stored records shall be appended with new sample data, allowing records to be accumulated. Systems that write over stored records shall not be allowed unless limited file size is specified. System database shall be capable of storing up to 50 million records before needing to archive data. Samples may be viewed at the web client. Operator shall be able to view all trended records, both stored and archived. All trend log records shall be displayed in standard engineering units.

2. AWS shall be capable of trending on an interval determined by a polling

rate, or changeof-value.

3. AWS shall be able to change Trend log setup information. This includes the information to be logged as well as the interval at which it is to be logged. All operations shall be password protected. Viewing may be accessed directly from any and all graphics on which a trended object is displayed.
4. AWS shall include a Trend log Wizard for setup of logs. Wizard shall walk user through all necessary steps. Wizard shall have its own pull-down selection for startup, or may be started by right-clicking on value displayed on graphic, and then selecting Trend logs from the displayed menu.
5. AWS shall be capable of using Microsoft SQL as the system database.
6. Any displayed data that is changeable by the operator may be selected using the right mouse button and the trend log shall then be selectable on the screen. Selection of the trend log using this method shall allow the viewing of the trend log view.
7. Trend log viewer shall provide:
 - a. Software that is capable of graphing the trend logged object data shall be included.
 - b. Access and ability to create, edit and view are restricted to users by user account credentials
 - c. Specific and repeatable URL defines the trend log(s) that comprise the view
 - d. Call out of trend log value at intersection of trend line and mouse-over vertical axis.
 - e. Trend log and companion logs can be configured to display on one of two independent vertical scales.
 - f. Click zoom for control of data set viewed along either graph axis.
 - g. User specifiable start and end dates as well as a fast scroll features that that supports click zoom of macro scale view of the data for quickly finding data set based on visual signature.
 - h. User export of the viewed data set to MS Excel.
 - i. Web browser based help
 - j. Optional min/max ranges (Upper Control Limits, Lower Control Limits)

for each value.

J. Energy Log Information – As Scheduled

1. AWS shall be capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files shall be appended with new data, allowing data to be accumulated. Systems that write over archived data shall not be allowed unless limited file size is specified. Display all energy log information in standard engineering units.
2. All data shall be stored in database file format for direct use by third-party programs. Operation of system shall stay completely online during all graphing operations.
3. AWS Operator shall be able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. All meters monitored by the system may be logged. System shall support using flow and temperature sensors for BTU monitoring.
4. AWS shall display archived data in tabular format form for both consumption and peak values. Data shall be shown in hourly, daily, weekly, monthly and yearly formats. In each format, the user shall be able to select a specific period of data to view.

K. Demand Limiting – As Scheduled

1. AWS shall include demand limiting program that includes two types of load shedding. One type of load shedding shall shed/restore equipment in binary fashion based on energy usage when compared to shed and restore settings. The other type of shedding shall adjust operator selected control setpoints in an analog fashion based on energy usage when compared to shed and restore settings. Shedding may be implemented independently on each and every zone or piece of equipment connected to system.
2. Binary shedding shall include minimum of five (5) priority levels of equipment shedding. All loads in a given priority level shall be shed before any loads in a higher priority level are shed. Load shedding within a given priority level shall include two methods. In one, the loads shall be shed/restored in a “first off-first on” mode, and in the other the loads are just shed/restored in a “first off-last on” (linear) fashion.
3. Analog shed program shall generate a ramp that is independently used by each individual zone or individual control algorithm to raise the appropriate cooling setting and lower appropriate heating setting to reduce energy usage.

4. AWS shall be able to display the status of each and every load shed program. Status of each load assigned to an individual shed program shall be displayed along with English description of each load.

L. Tenant Activity – As Scheduled

1. AWS shall include program that monitors after-hours overrides by tenants, logs that data, and generates a bill based on usage and rate charged for each tenant space. Tenant Activity program shall be able to assign multiple zones, from a list of every zone connected to system, to a particular tenant. Every zone is monitored for after-hour override usage and that data logged in AWS. Operator may then generate a bill based on the usage for each tenant and the rate charged for any overtime use.
2. Configuration shall include entry of the following information for use in logging and billing:
 - a. Tenant's contact name and address
 - b. One or multiple tenant zones that make up a total tenant space, including a separate billing rate for each separate zone
 - c. Minimum and maximum values an event duration and event limit
 - d. Property management information
 - e. Overall billing rate
 - f. Seasonal adjustments or surcharge to billing rate
 - g. Billing notification type such including, but not limited to printer, file and email
 - h. Billing form template
3. Logging shall include recording the following information for each and every tenant event:
 - a. Zone description
 - b. Time the event begins
 - c. Total override time
 - d. Limits shall be applied to override time
4. A tenant bill shall be generated for a specific period using all the entered

configuration data and the logged data. User with appropriate security level shall be able to view and override billing information. User shall be able to select a billing period to view and be able to delete events from billing and edit a selected tenant activity event's override time.

M. Reports

1. AWS shall be capable of periodically producing reports of trend logs, alarm history, tenant activities, device summary, energy logs, and override points. The frequency, content, and delivery are to be user adjustable.
2. All reports shall be capable of being delivered in multiple formats including text- and comma-separated value (CSV) files. The files can be printed, emailed, or saved to a folder, either on the server hard drive or on any network drive location.

N. Configuration/Setup

1. Provide means for operator to display and change system configuration. This shall include, but not be limited to, system time, day of the week, date of daylight savings set forward/set back, printer termination, port addresses, modem port and speed, etc. Items shall be modified using understandable terminology with simple mouse/cursor key movements.

O. Field Engineering Tools

1. AWS shall include field engineering tools for programming all controllers supplied. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from other types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.
2. User shall be able to select a graphical function block from menu and place on screen. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.
3. Programming tools shall include a real-time operation mode. Function blocks shall display real-time data and be animated to show status of data inputs and outputs when in real-time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.
4. Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics.

Operator shall be able to select unit type, input/output configuration and other items that define unit to be controlled. Supply minimum of 250 applications as part of workstation software.

5. Field engineering tool shall include Device Manager for detection of devices connected anywhere on the BACnet network by scanning of the entire network. This function shall display device instance, network identification, model number, and description of connected devices. It shall record and display software file loaded into each controller. A copy of each file shall be stored on the computer's hard drive. If needed, this file shall be downloaded to the appropriate controller using the mouse.
6. AWS automatically notify the user when a device that is not in the database is added to the network.
7. AWS shall include backup/restore function that will back up entire system to selected medium and then restore system from that media. The system shall be capable of creating a backup for the purpose of instantiating a new client PC.
8. The system shall provide a means to scan, detect, interrogate, and edit third-party BACnet devices and BACnet objects within those devices.

P. Workstation Hardware – As Scheduled

1. Provide operator's workstation(s) at location(s) noted on the plans.
2. AWS Server
 - a. 64-bit OS Required
 - b. Windows 10 Pro or Enterprise or Windows Server 2019
 - c. Quad-core or Eight-core processors.
 - d. 8 GB RAM or higher.
 - e. 500 GB (or higher) hard drive
 - f. Network interface card (10/100/1000 Mbps).

Q. Software

1. Provide 10 concurrent "Thick Client" Engineering Workstation Licenses for Programming / Configuration.
2. At the conclusion of project, contractor shall leave with owner a CD ROM

that includes the complete software operation system and project graphics, setpoints, system parameters, etc. This backup shall allow the owner to completely restore the system in the case of a computer malfunction.

R. WEB Client

1. BAS supplier shall provide an HTML5 based browser access to the AWS as part of standard installation. User must be able to access all displays of real-time data that are part of the AWS using a standard Web browser. Web browser shall tie into the network through owner-supplied Ethernet network connection. The AWS must be able to support 20 concurrent web client users at a minimum.
2. Browser shall be latest version of Microsoft Edge, Firefox and Chrome. No special vendorsupplied software shall be needed on computers running browser. Data shall be displayed in real-time and update automatically without user interaction.
3. Web pages shall be automatically generated using HTML 5 from the data display files that reside on the AWS. Any system that requires use of an HTML editor for generation of Web pages shall not be considered.
4. Access through web client or thick client shall utilize the same hierarchical security scheme as the AWS. User shall be asked to log on once the client makes connection to the AWS. Once the user logs in, any and all changes that are made shall be tracked by the AWS. The user shall be able to change only those items he or she has authority to change. A user activity report shall show any and all activity of the users who have logged in to the system, regardless of whether those changes were made using a web client, thick client or through the AWS.

S. Graphic Based Displays: For each system.

1. Operator Workstation: Point data for each system. Update every 30 seconds.
2. Dynamically update data any action by user.
3. Graphic Displays: Iconic graphic representations of mechanical equipment. Display graphic files, text, trendlog, and dynamic object data displays including animation.
4. Graphic Displays: "Drill Down" capability from main display to more specific system displays or navigations tree for building equipment and system diagnostic centric display organization.

5. Tree Navigation Contents: Customizable per-user and per-group basis.
 6. Systems with Terminal Unit Controls: Building floor plan with dynamic temperatures, drillable for more specific terminal information.
 7. Points on graphics allow user to change field-resident Operator Workstation functions associated with project, including setpoints, weekly and exception schedules, from any screen, whether screen shows text or graphic display. Do without reference to object addresses or other numeric/mnemonic indications.
 8. Protect display views unless operator credentials have proper access level. Assign access levels to each display/system object. Menu labels not to appear on graphic if operator does not have appropriate security level.
 9. Analog objects: Displayed with operator modifiable units. Input objects may be displayed as graphic items on display screen as an overlay to the system graphic.
 10. Information: Labeled with descriptors and shown with appropriate engineering units.
 11. DDCs system must provide graphic displays and files. Systems requiring graphics development or logic programming are prohibited. Graphic Files: JPG, GIF or PNG.
 12. Submit graphic displays to Owner for review and approval. Approved graphics to be in place prior to commissioning.
 13. Operator Workstation: Supply graphics library, to use unaltered or modified. Include library to assemble custom graphics. System to allow creation of new graphics.
 14. Data Displays: Ability to link to content outside of BAS system. Content to include, but not limited to launching external files in their native applications.
- T. OmniGraphics: Graphics with custom geometry offering color gradient shading and variable opacity in scale to system variables; analog and binary, and color range settings.
1. OmniGgraphics Must Support:
 - a. Displaying current values in the geometric shapes.
 - b. Geometric shapes to be clickable allowing another graphic display.

- c. Color Scale: Support using AV's to define the color scale ranges.

2.2 CONTROL PROGRAMMING SOFTWARE

- A. All DDC programming throughout the EMS network shall adhere to the following standards:
 - 1. Programming on all controllers must be completely operator definable and modifiable and must use a single common programming language for all control devices. Use of pre-canned, factory burned-in DDC programming on controllers is not acceptable and is grounds for rejection of EMS system.
 - 1. Programming shall be developed in an object-oriented graphical programming environment. Line by line code programming is specifically prohibited and is not acceptable.
 - 2. Programming must accommodate all written sequences of operations.
 - 3. Programming shall be modifiable from any server PC, operator console PC and/or portable laptop PC workstation without requiring the burning of new chips or having to directly access the local controller. Software shall accommodate the downloading of programming via established network Ethernet or modem connections.
 - 4. Programming must support the use of virtual software points in the same manner as all physical points are supported.
 - 5. All programming points, virtual or real, for any specific device in the entire EMS network shall be accessible to all other network devices at any given time, regardless of physical location.
 - 6. All programming shall adhere to the BACnet protocols for Standard Command Priorities.
 - 7. Programming software must include a pre-developed cohesive PID (proportional integral-derivative) algorithm whereby a user can adjust gain and anti-windup coefficients accordingly to effectively accomplish advanced sequence of operation requirements.

2.3 EXISTING BUILDING (GLOBAL) CONTROLLER

A. General Requirements

- 1. BACnet Conformance
 - a. Building Controller shall be approved by the BTL as meeting the BACnet Building Controller requirements.

- b. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
2. Building controller shall be of scalable design such that the number of trunks and protocols may be selected to fit the specific requirements of a given project.
3. The controller shall be capable of panel-mounted on DIN rail and/or mounting screws.
4. The controller shall be capable of providing global control strategies for the system based on information from any objects in the system, regardless if the object is directly monitored by the building controller module or by another controller.
5. The controller shall be capable of running up to six independent control strategies simultaneously. The modification of one control strategy does not interrupt the function or runtime others.
6. The software program implementing the DDC strategies shall be completely flexible and user-definable. All software tools necessary for programming shall be provided as part of project software. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, using a WAN or downloaded through remote communications are not acceptable. Changing global strategies using firmware changes is also unacceptable.
7. Programming shall be object-oriented using control function blocks, and support DDC functions, All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on workstation. The same tool shall be used for all controllers.
8. Programming tool shall provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed using the operator's workstation or field computer.
9. Controller shall have 6000 Analog Values and 6000 Binary Values
10. Controller IP configuration can be done via a direct USB connect with an operator's workstation or field computer.

11. Controller shall have at a minimum a Quad Core 996Ghz processor to ensure fast processing speeds.
12. Global control algorithms and automated control functions shall execute using a 64-bit processor.
13. Controller shall have a minimum of 1 GB of DDR3 SDRAM on a 533Mhz bus to ensure high speed data recording, large data storage capacity and reliability.
14. Controller shall support two on-board EIA-485 ports capable of supporting various EIA485 protocols including but not limited to BACnet MS/TP and Modbus.
15. Controller shall support two additional EIA-485 option cards, each providing two EIA-485 ports capable of supporting various EIA-485 protocols including but not limited to BACnet MS/TP and Modbus
16. Controller shall support two gigabit speed Ethernet (10/100/1000) ports.
 - a. Ports are capable of supporting various Ethernet protocols including but not limited to BACnetIP, FOX, and Modbus.
17. All ports shall be capable of having protocol(s) assigned to utilize the port's physical connection
18. The controller shall have at a minimum four onboard inputs, two universal inputs and two binary inputs.
19. Schedules
 - a. Building controller modules shall provide normal seven-day scheduling, holiday scheduling and event scheduling.
 - b. Each building controller shall support a minimum of 384 BACnet Schedule Objects and 384 BACnet Calendar Objects.
20. Logging Capabilities
 - a. Each building controller shall log as minimum 1920 objects at 15 min intervals. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
 - b. Logs may be viewed both on-site or off-site using WAN or remote communication.
 - c. Building controller shall periodically upload trended data to networked

operator's workstation for long-term archiving if desired.

- d. Archived data stored in database format shall be available for use in thirdparty spreadsheet or database programs.

21. Alarm Generation

- a. Alarms may be generated within the system for any object change of value or state (either real or calculated). This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
- b. Each alarm may be dialed out as noted elsewhere.
- c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
- d. Controller must be able to handle up to 1920 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.

22. Demand Limiting

- a. Demand limiting of energy shall be a built-in, user-configurable function. Each controller module shall support shedding of up to 1200 loads using a minimum of two types of shed programs. Each building controller shall support up to 10 unique demand limiting program modules
- b. Load shedding programs in building controller modules shall operate as defined in section 2.1.J of this specification.

23. Tenant Activity Logging

- a. Tenant Activity logging shall be supported by building controller module. Each independent module shall support a minimum of 384 zones.
- b. Tenant Activity logging shall function as defined in section 2.1.K of this specification.

B. BACnet MS/TP

- 1. BACnet MS/TP LAN must be software-configurable from 9.6 to 115.4Kbps
 - a. Each BACnet MS/TP LAN shall support 64 BACnet devices at a minimum

- b. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. BACnet IP

1. The building controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. 2. Must support communications using BACnet/IPv4 and/or BACnet/IPv6
2. Must support interoperability on WANs and CANs and function as a BACnet Broadcast Management Device (BBMD).
3. Each controller shall support at a minimum 128 BBMD entries
4. BBMD management architecture shall support 3000 subnets at a minimum
5. Shall support BACnet Network Address Translation
6. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

D. Expansion ports

1. Controller shall support two expansion ports.
 - a. Combining the two on-board EIA-458 ports with fully loaded expansion ports the controller shall support (6) EIA-485 trunks simultaneously
2. Expansion cards that mate to the expansion ports shall include:
 - a. Dual port EIA-485 card and EIA-232 card

E. Modbus Protocol Support:

1. Controller shall support reading from and writing to TCP Slaves and Serial Connections (RTU or ASCII over either EIA-485 or EIA-232).
 - a. Shall be capable of mapping Modbus register coil data to BACnet AV, BV, MV, AI, BI, and MI object types.
 - b. Support a minimum of 6000 Mapped Modbus points.
2. Support up to 384 virtual groupings of Modbus points where each grouping

is represented as a single virtual BACnet device.

- a. Virtual BACnet devices support BACnet Change Of Value (COV) notifications
- b. Each Virtual device has diagnostic information for troubleshooting Modbus point mapping. Diagnostic point should include the following.
 1. Number of points mapped.
 2. Number of messages Transmitted and Received.
 3. Modbus Exception Counts.
 - iv. Display of last exception message.
 4. v. Serial Setting (Baud rate, Parity, Stop Bits).
3. Integration Performance: Data age of integrated point shall be capable of 1 second for 5000 points.

F. Power Supply

1. Input for power shall accept between 17–30VAC, 47–63Hz.
2. Optional rechargeable battery for shutdown of controller including storage of all data in flash memory
3. On-board capacitor will ensure continuous operation of real-time clocks for minimum of 14 days.

G. Controller shall be in compliance with the following

1. UL 916 for open energy management
2. FCC Class B
3. ROHS
4. IEC 60703
5. C-Tick Listed
6. CE (EN 60730-1)

H. Controller shall operate in the following environmental conditions:

1. -4 to 149 °F (-20 to 65 °C) without optional battery, or 32 to 122 °F (0 to 50 °C) with optional battery

2. 0 to 95% RH, non-condensing.

2.4 ADVANCED APPLICATION CONTROLLERS

- A. Provide one or more native BACnet advanced application controllers for HVAC equipment requiring DDC standalone control independent of building control module operation. All controllers shall interface to building controller through either MS/TP LAN using BACnet protocol, or Ethernet LAN using BACnet over Ethernet or BACnet TCP/IP. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of units. Controllers shall be fully programmable using graphical programming blocks. Programming tool shall be resident on operator workstation and be the same tool as used for the building controller. No auxiliary or non-BACnet controllers shall be used.
- B. BACnet Conformance
 - a. Application controllers shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements.
 - b. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 - c. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Multi-state Values, Device, File, and Program object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Application controllers shall include universal inputs with 12-bit resolution that accept 3K and 10K thermistors, 0–10VDC, Platinum 1000 Ohm RTD, 0–5VDC, 4–20mA and dry contact signals. Any input on a controller may be either analog or digital with a minimum of three (3) inputs that accept pulses. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall include binary and analog outputs on board. Analog outputs with 10-bit resolution shall support either 0–10VDC or 0–20mA. Binary outputs shall have LED indication of status. Software shall include scaling features for analog outputs. Application controller shall include 20VDC voltage supply for use as power supply to external sensors.

1. All outputs must have on-board Hand-Off-Auto (HOA) switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position. The position of each and every HOA switch shall be available system wide as a BACnet object property.
- D. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller up to 20 times per second (minimum of 10 times per second) and capable of multiple PID loops for control of multiple devices. All calculations shall be completed using floating-point math and system shall support display of all information in floating-point nomenclature at operator's terminal.
1. The following control blocks shall be supported:
 - a. Natural Log
 - b. Exponential
 - c. Log base 10
 - d. X to the power of Y
 - e. Nth square root of X
 - f. 5th Order Polynomial Equations
 - g. Astronomical Clock (sunrise/sunset calculation)
 - h. Time-based schedules
- E. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely using modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using programming tools as described in operator's terminal section.
- F. Application controller shall include support for intelligent room sensor (see Section 2.9.B.) Display on intelligent room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode, based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

G. Schedules

1. The controller shall support a minimum of three (3) BACnet Schedule Objects and have a real-time clock on board with battery backup to maintain time through a power loss.

H. Logging Capabilities

1. Controller shall support a minimum of 50 trend logs. Any object in the controller (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
2. Controller shall periodically upload trended data to system server for long-term archiving if desired. Archived data stored in (MS Jet Database or SQL) database form and shall be available for use in third-party spreadsheet or database programs.

I. Alarm Generation

1. Alarms may be generated within the controller for any object change of value or state (either real or calculated). This includes things such as analog object value changes, and binary object state changes.
2. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
3. Controller must be able to handle up to 25 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.

J. The controller processor shall be a 64-bit processor.

K. The packaging of the controller shall provide operable doors to cover the terminals once installation is complete. The housing of the controller shall provide for DIN rail mounting and also fully enclose circuit board.

2.5 APPLICATION SPECIFIC CONTROLLERS

A. Provide one or more native BACnet application controller for HVAC equipment requiring DDC standalone control independent of building control module operation and for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller through MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.

B. BACnet Conformance

1. Application controllers shall, as a minimum, support MS/TP BACnet LAN

types. They shall communicate directly using this BACnet LAN at 9.6, 19.2, 38.4, 76.8, and 115.2 Kbps, as a native BACnet device. Application controllers shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements and support all BACnet services necessary to provide the following BACnet functional groups:

- a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
2. Please refer to Section 22.2, BACnet Functional Groups in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Application controllers shall include universal inputs with 16-bit resolution that can accept 3K and 10K thermistors, 0–5VDC, 4–20mA, dry contact signals and a minimum of three (3) pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.
- D. All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely through modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.
- E. Application controller shall include support for intelligent room sensor (see Section 2.9.B.) Display on room sensor shall be programmable at controller

and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

2.6 BACnet THERMOSTAT

- A. General. Provide a fully programmable BACnet MS/TP thermostat equipped with onboard inputs and outputs. The BACnet Thermostat shall have a standard temperature sensor with humidity, CO2 and motion options. The display shall include a RGB LED backlight for multicolor LCD and button illumination that provides additional user feedback and esthetic appeal. NFC technology shall enables installers to use NFC-enabled mobile devices to configure the thermostat.
1. The BACnet Thermostat shall operate on 24VAC or 24VDC power.
 2. The BACnet Thermostat shall have sufficient memory to support its operating system, database, and programming requirements.
 3. BACnet Thermostats shall be fully peer to peer.
 4. The operating system of the Controller shall manage the input and output communication signals to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms.
 5. All equipment that requires scheduling shall be scheduled in that equipment's controller.
 6. Both firmware and controller database shall be loadable over the network.
 7. BACnet Thermostat shall support the following sensors:
 - a. Digital Temperature Sensor +/- 0.2°C (+/- 0.36°F)
 - b. Digital Humidity Sensor Accuracy +/- 3%
 - c. CO2 Sensor Dual Beam, Self Calibrating NDIR Detection Range: 0-2000 ppm
 - d. Occupancy Sensor Passive infrared motion (PIR) sensor Range: 5 m (16.4 ft.) Coverage: 100° Horizontal
 8. Thermostat backlight shall illuminate automatically based on user interaction. Where motion detection option is specified, backlight shall activate automatically based on user approach. In both cases, backlight shall dim based on programmable timeout.

9. Specified thermostat shall have RGB backlight capable of displaying a range of colors. Backlight shall be (programmable \ user adjustable \ variable based on input).
10. The thermostat backlight shall signify when the controlled equipment has been commanded into heating, cooling or economy mode with a red, blue and green light respectively.
11. The thermostat shall signal when an alarm has been sent from the third party notification system. The thermostat will display a flashing color as specified by the alarm code of the occupant.
12. The provided thermostat shall have backlit buttons or a backlit button interface allowing full use of all features and functions of the device in a dark environment.
13. Specified thermostat must have NFC communication chip onboard allowing for wireless configuration and addressing of the device via smartphone, tablet or other like device.
14. The thermostat must have universal external inputs capable of reading a dry contact, remote wired temperature sensors, or 0-5VDC / 0-10VDC signal.
15. Binary outputs shall be solid-state type, capable of switching 24VAC or 24VDC, both internally or externally sourced up to 0.5Amp current.
16. Analog outputs shall support 0-10VDC with up to 20mA current.
17. The thermostat shall support trend logs capable of storing data locally on the controller. This data shall be written to serial type memory as to persist through loss of power.

B. Communication

1. Each BACnet Thermostat shall support BACnet MS/TP, at 9,600/19,200/38,400/76,800bps baud rates.
2. The controller shall provide a service communication port using BACnet Data Link/ Physical layer protocol for connection to portable operator's workstation and allow access to the entire network.
3. The thermostat shall have a service port for local network access, capable of being enabled or disabled through software.

C. Environment. Controller hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at 0° to 55°C (32° to 131°F), 10 - 90% RH (non-condensing).
- D. Memory. The BACnet Thermostat shall utilize non-volatile FLASH memory to maintain its operating system and backup all operator entered changes to setpoints, schedules, and commands.

2.7 AUXILIARY CONTROL DEVICES

A. Temperature Sensors

1. All temperature sensors to be solid-state electronic, interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Mount 48 inches above finished floor. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake, and in a location that is in the shade most of the day.

B. Intelligent Room Sensor with Touch Screen

1. Hardware

- a. Room sensor shall include:
 1. Backlit touch screen LCD digital display
 2. Temperature sensor
 3. Humidity Sensor
 4. Programmable Smart Light indicator
 5. CO2 Sensor (as scheduled on prints)
- b. Temperature sensor shall be a Uni-Curve Type II thermistor with an accuracy of +/- 0.36 °F (0.2 °C) at calibration point over the range of 32-116 °F or better.
- c. Humidity sensor shall have an accuracy of +/-3% from 10-90% relative humidity or better.
- d. The intelligent room sensor's Smart Light shall have a minimum of four colors (Blue, Red, Amber and Green) that will cast a glow onto the wall

below the sensor to be used as visual indicator to the occupants of the condition of the system. The color and on/off state of smart light shall be fully programmable.

- e. CO2 Sensor shall have an accuracy of +/- 30 ppm over the range of 0-5000 ppm or better.
- f. CO2 sensor shall utilize Automatic Baseline Correction to maintain sensor calibration without need for manual calibration.
- g. The user shall interact with the intelligent room sensor using a touch screen, with no buttons allowed.
- h. The intelligent room sensor shall have provisions for a tamper proof installation requiring tools to be removed from the wall.
- i. The touch screen shall have a surface hardness of Mohs 7 or greater to prevent being easily scratched.
- j. Controller shall function as room control unit and allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator.

2. Display Content

- a. The intelligent room sensor shall simultaneously display room setpoint, room temperature, and outside temperature at each controller.
- b. The intelligent room sensor shall have the ability to add or remove from the display time-of-day, room humidity, and indoor air temp to customize the view for the customer.
- c. The intelligent room sensor must have the capability to show temperatures in degrees Fahrenheit or degrees Centigrade.
- d. A communication loss or improper communications wiring shall be displayed on the LCD screen to aid in trouble shooting.
- e. Information about the version of firmware shall be displayable on the LCD screen.
- f. A cleaning mode will be provided to allow for the touch screen to be cleaned without inadvertently making changes to system parameters.
- g. The intelligent room sensor shall have the ability to display the status of a lighting zone and control the on/off state of the zone from the touch screen using a tenant accessible display page.

- h. The intelligent room sensor shall have the ability to display the status of a window zone (e.g. blinds) and control the on/off state of the zone from the touch screen using a tenant accessible display page.
 - i. After Hours Override shall provide for the following:
 - 1. Override time may be set and viewed in 30-minute increments.
 - 2. Override time countdown shall be automatic but may be reset to zero by occupant from the sensor.
 - 3. Time remaining shall be displayed.
 - j. Display shall show the word "OFF" in unoccupied mode unless a function button is pressed.
3. Other Modes
- a. The intelligent room sensor shall also allow service technician access to hidden functions for advanced system configuration. This functionality shall be accessed protected with a configurable pin number.
 - b. Field service mode shall allow access to common parameters as dictated by the application's sequence of operations. The parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.
 - c. Balance mode shall, if intelligent room sensor is connected to VAV controller, allow a VAV box to be balanced and all air flow parameters viewed. The balancing parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.
4. Intelligent Room Sensor shall be in compliance of the following:
- a. UL Standard for Safety 916
 - b. FCC Part 15.107 & 109, Class B, CFR47-15
 - c. EMC Directive 89/336/EEC (European CE Mark) 5. Manufacturer: Alerton MicroSet 4 or approved equal.

C. Sensors

- 1. Standard wall sensor shall use solid-state sensor identical to intelligent room sensor and shall be packaged in aesthetically pleasing enclosure. Sensor shall provide override function, warmer/cooler lever for set point adjustment

and port for plug-in of Field Service Tool for field adjustments. Override time shall be stored in controller and be adjustable on a zone-by-zone basis. Adjustment range for warmer/cooler lever shall also be stored in EEPROM on controller. All programmable variables shall be available to field service tool through wall sensor port.

2.

Manufacturer	Alerton or Approved Equal
Model	MicroTouch
Temperature Monitoring Range	32°F to 158°F
Output Signal	Changing resistance (10K Ω)
Accuracy at Calibration Point	$\pm 0.36^\circ\text{F}$ (+/- 0.2°C)
Set Point and Display Range	N/A Blank

3. Duct Temperature:

Manufacturer	ACI or Equal
Model	TS-20XX-FB-10-AA (4", 6", 8", 12")
Calibration Adjustments	N/A
Temperature monitoring range	32°F to 158°F
Output signal	Changing resistance (10K Ω)
Accuracy at Calibration point	$\pm 0.36^\circ\text{F}$ (+/- 0.2°C)

4. Outside air temperature:

Manufacturer	Dwyer or Equal
Model	TE-RND-B
Calibration Adjustments	N/A
Temperature monitoring range	0°F to 150°F
Output signal	Changing resistance (10K Ω)
Accuracy at Calibration point	$\pm 0.4^\circ\text{F}$ (+/- 0.22°C)

D. Standalone Carbon Dioxide

1. General

- a. Detachable base with all field wiring termination on base.
- b. Factory calibrated and set to 0-2000 PPM range

- c. Response time shall be 1 minute or less.
- d. 5-year calibration interval (recommended).
- e. Rated ambient conditions:
 - 1. Air temperature: 32°F - 122°F
 - 2. Relative humidity: 0% - 95% non-condensing
- f. Signal output: 4-20 mA or 0-10 V.
- g. Non-dispersive single beam infrared sensor.
- h. Accuracy: larger of ± 30 PPM or 2% measured value.
- i. Sensor shall have self-calibration algorithm which improves long-term stability and accuracy.
- j. Manufactures: Veris CDE & CWE Series or equal

E. Switches and Status Indicators

1. Current Switch

- a. Solid-core or split-core
- b. Range as required by application
- c. Adjustable trip point
- d. Switch:
 - 1. Solid state
 - 2. Normally open
 - 3. Relay output: minimum 120 VAC or VDC, 0.3 Amps.
 - 4. Zero off state leakage
- e. Low Frequency Limit: 6 Hz
- f. LED trip indicator
- g. UL and CSA approved
- h. May be used to start other devices if so indicated on Building

Automation Drawings.

- i. Manufacturers Veris Industries or Equal

F. Control Relays

1. All control relays shall be UL listed, enclosed, with LED energized indicator.
2. All relays shall have contact rating, configuration and coil voltage suitable for the application.
3. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:
 - a. AC coil pull-in voltage range of +10%, -15% or nominal voltage.
 - b. Coil sealed volt-amperes (VA) not greater than 4 VA.
 - c. Pilot light indication of power-to-coil and coil retainer clips.
4. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load.
5. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.
6. Manufacturer: Functional Devices RIB, Veris, Idec or Equal

2.8 ELECTRONIC ACTUATORS

A. Quality Assurance for Actuators

1. UL Listed Standard 873 and C.S.A. Class 4813 02 certified.
2. NEMA 2 rated enclosures for inside mounting, provide with weather shield for outside mounting.
3. Five-year manufacturer's warranty. Two-year unconditional and three-year product defect from date of installation.

B. Execution Details for Actuators and Valves

1. Damper actuation shall be floating type or analog (2–10 VDC, 4–20 mA).

C. Actuators for damper 0.5–6 inches shall be electric unless otherwise specified, provide actuators as follows:

1. UL Listed Standard 873 and Canadian Standards Association Class 481302

shall certify actuators.

2. NEMA 2 rated actuator enclosures for inside mounting. Use additional weather shield to protect actuator when mounted outside.
3. Five-year manufacturer's warranty. Two-year unconditional and three-year product defect from date of installation.
4. Fail safe shall be provided when specified. Capacitors or spring return.
5. Position indicator device shall be installed and made visible to the exposed side of the actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the actuator.
6. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for butterfly valve actuators.
7. A pushbutton gearbox release shall be provided for all non-spring actuators.
8. Modulating actuators shall be 24 VAC and consume 10 VA power or less.
9. Conduit connectors are required when specified and when code requires it.

D. Damper Actuators

1. Air Handler Economizer actuators shall utilize analog control 2–10 VDC; floating control is not acceptable.
2. Electric damper actuators shall be direct shaft-mounted and use a V-bolt and toothed Vclamp causing a cold weld effect for positive gripping. Single bolt or set-screw type fasteners are not acceptable.
3. Size actuators for sufficient torque for damper area. Small outside air and return air economizer damper sections may be mechanically linked together if one (1) actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
4. Actuator mounting for damper arrangements shall comply with the following:
 - a. Damper actuators: Shall not be installed in the air stream if possible.
 - b. A weather shield shall be used if actuators are located outside.

- c. Damper actuator ambient temperature shall not exceed 122 degrees F through any combination of medium temperature or surrounding air. Appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation shall be provided as necessary.
- d. Actuator cords or conduit shall incorporate a drip leg if condensation is possible. Water shall not be allowed to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point shall be avoided to prevent water from condensing in conduit and running into actuator.
- e. Damper mounting arrangements shall comply to the following:
 - 1. The ventilation subcontractor shall furnish and install damper channel supports and sheet metal collars.
 - 2. Jack shafting of damper sections is be allowed as long as the total combined section does not exceed 50 ft²
- f. Multiple section dampers of two or more shall be arranged to allow actuators to be direct shaft mounted on the outside of the duct.

2.9 ENCLOSURES

- A. All controllers, power supplies and relays shall be mounted in enclosures.
- B. Interior enclosures shall be NEMA1, exterior enclosures shall be NEMA3R.
- C. Enclosures shall have hinged, locking doors.
- D. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 1/8" thick sized appropriately to make label easy to read.
- E. All temperature control panels shall be fabricated in a UL-listed panel shop. Field assembled temperature control panels are not allowed.

2.10 EXISTING POWER SUPPLIES AND CONTROL TRANSFORMERS

- A. Basis of design PSH500 from functional devices.
- B. Provide 120V plug receptacle in all panels with terminal unit routers.
- C. Control transformers and power supplies shall be UL-Listed.
- D. Provide Class 2 current-limiting type or over-current protection in both primary and secondary circuits for Class 2 service per NEC requirements.

1. Transformer shall be properly sized for application. Limit connected loads to 80% of rated capacity.
 2. Line voltage units shall be UL Recognized and CSA Approved.
- E. DC Power Supplies: DC power supply output shall match output current and voltage requirements. Power supply shall be full-wave rectified type with the following minimum Specifications:
1. Built-in overvoltage and overcurrent protection and able to withstand a 150% current overload for a minimum of three (3) seconds without tripping or failure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this section may properly commence.
- B. Notify the owner's representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until all unsatisfactory conditions are resolved.

3.2 GENERAL

- A. Install all line voltage wiring, concealed or exposed, in accordance with Division 26.
- B. All concealed control and low voltage wiring (above ceilings and in walls) may be installed in plenum rated cable.
- C. Supply/Install all necessary transformers/power supplies as required to power BAS instrumentation.
- D. DDC Contractor shall coordinate with other trades as required by Section 23 09 23. This shall include submitting documentation and coordination plans as described in that Section.
- E. DDC Contractor shall protect all products and retain them in manufacturer packaging until installed, as required by Section 23 09 23.
- F. DDC Contractor shall perform all Work under this Section in accordance with the manufacturer's instructions and the general workmanship requirements specified in Section 23 09 23 and in Division 23. DDC Contractor shall in

addition observe the following requirements:

1. All sensors and products shall be mounted rigidly and adequately supported.
 2. Wires attached to sensors shall be sealed against bulk air movement in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
 3. Sensors which provide data used to maintain a setpoint with variable-speed equipment (e.g. duct pressure sensor used for fan speed control, or end-of-loop differential pressure used for pump speed control) shall be hardwired directly to the same controller that controls the variable-speed equipment, which shall also be the controller where the variable speed control loop resides.
- G. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum three (3) feet of clear access space in front of units. Obtain approval on locations from owner's representative prior to installation.
- H. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture, and high or low temperatures.
- I. Ethernet and Fiber network requirements are to be governed by Division 26 and Division 27 requirements.
- J. Underground conduit and wiring are only required where meters or alarm devices are necessarily located underground. Such wiring to be governed by associate spec sections and provided by respective trades.
- K. The selection and installation of line-voltage power wiring and wiring connections, including subpanels, conduit and raceways, required for Work in this Section shall be provided by the Division 26 contractor based on control panel locations pre-coordinated with the DDC Contractor.
- L. The selection and installation of low-voltage power wiring and wiring connections, including subpanels, conduit and raceways, required for Work in this Section shall be provided by the DDC Contractor.
- M. Where wiring specifications differ between Division 23 09 23 and other divisions, Division 23 09 23 shall take precedence when pertaining to Control, Communication, 24V wiring and associated conduit. This includes all IO, comm, and serial networks.
- N. The requirements of this section shall not supersede local or national codes.

3.3 POWER WIRING INSTALLATION

- A. Division 26 electrical contractor shall provide 120 volt, 20 amp circuits and circuit breakers from normal and/or emergency power panel for direct digital control systems.
- B. Division 23 09 23 contractor to provide documentation with panel locations and load requirements to Division 26.
- C. All 120V to BMS panels provided by division 26. General requirements for obtaining power include the following:
 - 1. Electrical service to controls panels and control devices shall be provided by isolated circuits, with no other loads attached to the circuit, clearly marked at its source. The location of the breaker shall be clearly identified in each panel served by it.
 - 2. Obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 460V source, obtain power from the electrically most proximate 120V source fed from a common origin.
 - 3. Where control devices are located in or on new equipment, coordinate with the equipment manufacturer and feed the control with the same source as the equipment. If the equipment's control transformer is large enough and of the correct voltage to supply the controls, it may be used. If the equipment's control transformer is not large enough or not of the correct voltage to supply the controls, provide separate transformer(s).
 - 4. Unless transformers are provided with equipment, DDC Contractor shall provide transformers for all low voltage control devices including terminal units. Transformer(s) shall be located in control panels in readily accessible locations.
- D. Emergency, Uninterruptible, and Backup Power
 - 1. UPS and Emergency power is not the responsibility of the DDC contractor unless otherwise indicated for a specific piece of equipment.
 - 2. Said power to be design and implemented in full by Division 26 engineer/contractor.
- E. Work shall comply with NEC with all state and local amendments, and all requirements of Division 26 Specification for power wiring.

3.4 CONTROL AND COMMUNICATION WIRING INSTALLATION

A. General

1. Terminate all control and/or interlock wiring.
2. Install wiring in raceway or conduit when located in unconcealed or inaccessible locations, locations subject to foot traffic in the normal course of building operations, locations where wires may be damaged including equipment rooms within 8 feet of floor, or as required by code or AHJ.
3. EMT conduit shall be used in the following applications:
 - a. Garage
 - b. Central plant
 - c. Cooling towers
 - d. AHU mechanical rooms
 - e. Vertical façade dampers, where cable is not concealed in window fascia plate.
 - f. Outdoor locations
 - g. Electrical Rooms.
 - h. Where exposed to damage.
4. Rigid conduit is not necessary unless required by AHJ.
5. Low voltage control signal and IO wiring may be installed without conduit or raceway in concealed, protected, and accessible locations such as above suspended ceiling, in underfloor spaces or spaces requiring a ladder or lift to access.
 - a. Suspended/supported plenum rated cable in above T-bar ceilings and in underfloor areas must be installed as follows:
 1. With ties or slip rings bundling runs or groupings of wiring at 8 ft intervals (+/- 1 ft).
 2. With ties or slip rings securing all wiring to duct or floor supports at 90-degree path runs.
 3. Laying wiring on the ground is acceptable so long as it is also cable or attached with slip rings to floor supports.
 4. This wiring is a permanent feature of the building and should not

be mixed in with data cabling. Using the same cable trays as Division 27 or any other computer network cabling is not acceptable.

6. Tacking wire to top of duct with magnetic bridal rings is acceptable. Drilling zip ties fasteners into duct for securing wiring is not acceptable. Cable tying or using slip rings attaching wiring to duct supports is acceptable.
 - a. Thermostat wiring does not require conduit in walls.
 7. In mechanical/electrical rooms EMT conduit is the only acceptable routing type for DDC wiring.
 8. Above hard lid ceilings with over a 30' span between access hatches EMT is the only acceptable routing type for DDC wiring.
 9. Flex conduit in lengths of 6ft or less for sensors in lieu or in conjunction with EMT conduit is acceptable.
 10. EMT for DDC systems can (and where feasible should) follow the ducts or pipes it serves. Sharing supports with this equipment is acceptable.
 11. Seismic ratings of equipment cannot be compromised. DDC contractor to use discretion where conflicts could arise, seismic takes precedence.
 12. Clad or Jacketed Cable is not in conformance with the owners wiring standards and therefore not an acceptable substitute for EMT conduit.
 13. Do not install communication or signal wiring in raceway or enclosures containing high- or low-voltage power wiring.
 14. Junction boxes may be used for terminal blocks to join sections of wire where long pulls or pulls with many bends are necessary.
 15. Up to 4 bends and 150ft are allowable between wire pull sections.
 16. Run direct current signal wires separately from alternating current conductors. Where allowed by code, AC and DC wiring routes shall only cross at a 90-degree angle.
 17. All temperature sensors on external walls shall have sealed handy boxes and foam backing plates to insulate the temperature sensor from drafts in the wall.
- B. All wiring shall be installed in a neat and workmanlike manner.
- C. Follow all manufacturers' installation recommendations.

D. Wiring not in conduit shall be installed as follows:

1. Routed parallel or perpendicular to building and/or mechanical lines.
2. Supported by or anchored as follows. Do not lay wiring on the ceiling.
3. Wire that is not used for Ethernet, TCP/IP, or BACnet IP networking may be secured to structural members or to supports for ductwork, piping, and raceways.
4. Wire that is used for Ethernet, TCP/IP, or BACnet IP networking (i.e. "category" cable) shall be supported from below by J-hooks, trays, or similar means. Do not kink or twist category cabling, and do not zip-tie it to its supports.
5. Installed in sleeves where it passes through walls and floors. Maintain fire, smoke, envelope and pressure ratings of each space.
6. All wire and cable installed in ceiling return plenums must be rated for plenum installation. If uncertain, contractor shall assume that above-ceiling spaces are plenums.
7. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
8. All wire-to-device connections shall be made at a terminal block or terminal strip.
9. All wire to wire connections for power shall be at a terminal block. Communication wire shall be continuous, with no wire-to-wire connections.
10. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

E. Shielding

1. Maintain continuous shielding of all communications and signal wiring.
2. Shields shall be grounded only at controller or power source end and floated at other end, unless otherwise recommended by the controller manufacturer.
3. Float shields through termination points, maintaining only on single grounding point and insulating from ground at all other points.

F. Identification

1. Use color-coded conductors consistently throughout the entire DDC System installation.
 2. All field wiring shall be properly labeled at each end.
- G. The DDC Contractor shall verify integrity of all wiring to ensure continuity and freedom from shorts and grounds after the installation is complete.
- H. All field wiring shall be properly labeled at each end for the following:
1. All central plant IO and comm
 2. All AHU IO and comm
 3. All terminal unit comm (no IO)

3.5 CONTROL AIR AND SENSING LINES

A. Installation methods and materials

1. Concealed and inaccessible: EMT conduit
2. Concealed and accessible (including ceiling return air plenums): Use hard or soft copper tubing or FR plastic tubing, subject to the following limitations
3. Splicing is acceptable. Use junction box or splice at pull boxes only when run in conduit.
4. Copper tubing: Use only tool-made bends.

B. Fittings and Sleeves

1. Where FR tubing exits the end of raceway or junction box, provide a snap-in nylon bushing. Where FR tubing exits control panels, provide bulkhead fittings.
2. Where copper tubing exits junction boxes or panels, provide bulkhead fittings.
3. Brass-barbed fittings shall be used at copper-to-FR tubing junctions. Plastic slipped over copper tubing is not acceptable.
4. Sleeve through concrete surfaces in minimum 1-inch sleeves, extended 6 inches above floors and 1 inch below bottom surface of slabs.

C. Number-code or color-code tubing at each end for identification and servicing of control system. Code shall be as indicated on approved shop drawings.

3.6 TAGS AND LABELING

A. Panel Face.

1. Provide phenolic tags with white letters, black background.
2. Attach to panels with adhesive.
3. Text size is to be 1/4" minimum.
4. Tags to include panel name and number.

3.7 AIR SENSORS AND DEVICES

A. Temperature Sensors

1. Single Point Duct Sensors

- a. Install probe at approximate midpoint of duct height.
- b. Install such that probe penetrates minimum 20% of duct width, to avoid boundary layer.
- c. If installing near a coil:
 1. Upstream of coil, install a minimum of 6 inches from coil.
 2. Downstream of coil, install a minimum of 12 inches from coil if possible, 6 inches absolute minimum.
 3. No part of the sensor or its support elements or conduit shall be in contact with the coil, coil framing or coil support elements. iv. .

2. Room Sensors and Thermostats

- a. Room sensors and thermostats shall be installed on concealed junction boxes properly supported by wall framing.
- b. Install all devices with insulated base.
- c. For sensors mounted in exterior walls, seal all junction box openings with mastic sealant and pack junction box with insulation.
- d. For sensors on exposed unfurred columns, use Wiremold or equal raceway
- e. that is smallest required to enclose wiring and Wiremold or equal junction boxes that are narrowest required to enclose sensor and wiring

connections. Color shall be per the architect; submit for approval prior to installation.

- f. Install sensors in locations as shown on Contract Drawing mechanical floorplans. If installation in indicated location is not feasible, notify the Engineer of Record.
- g. Unless otherwise noted on Contract Drawings, wall-mounted sensors shall be installed at same centerline elevation as adjacent electrical switches, 4 feet above the finished floor where there are no adjacent electrical switches, and within ADA limitations.
- h. Wall mounted CO2 sensors shall in all cases be installed between three and six feet above finished floor, to comply with code requirements.

3.8 SWITCHES AND STATUS INDICATORS

A. Current Switch

- 1. Adjust current setpoint (i.e. ON/OFF signal threshold) as follows:
 - a. For fan status, with discharge damper: Adjust so that fan status is OFF when fan discharge damper is fully closed while fan is running.
 - b. For fan status, with belt-driven fan: Adjust so that fan status is OFF when fan belt is broken and motor is running.
 - c. For pump status: Adjust so that pump status is OFF when pump is running with shutoff valves closed (i.e. pump is dead-headed).

3.9 DDC CONTROLLER INSTALLATION

A. Physical Installation

- 1. Central System Controllers and associated devices shall be assembled into panels or enclosures by DDC Contractor in a workshop environment.
- 2. Unitary Controllers (VAV Box, FCU, etc) may be direct mounted on equipment with no enclosure.
- 3. Install controllers in appropriately rated enclosures as required by field conditions and this Section.
- 4. Install all controllers in readily accessible location.
- 5. For every Central System Controller, provide a dedicated power switch if the controller does not include one built in.

6. Connect controllers to a power source of equal reliability (normal, emergency, uninterruptable, etc.) to the power source of the equipment being controlled.
7. HVAC systems and equipment served by a backup power source or UPS shall have associated DDC system products that control such systems and equipment also served from a backup power source or UPS.
8. Connect sensors, actuators and other attachments such that they can be quickly and easily disconnected for service. All wiring connections shall be made to field-removable, modular terminal strips.

B. Functional Installation

1. Configure DDC System to share data between networked controllers and other network devices.
 - a. Point information from any controller (including BCs, AACs, and ASCs) and from any gateway shall be capable of being used in a control sequence in any other panel.
 - b. The use of a computer or another DDC device as a communications server between control panels and/or gateways is not acceptable.
2. Each individual mechanical system or piece of equipment shall be controlled by no more than one controller with sufficient capacity to be connected to all field devices and sensors associated with that system and/or piece of equipment.
 - a. All points associated with and common to one unit or other complete system or equipment shall reside within a single controller (including I/O expander boards as allowed below). Point data which may be transmitted over the LAN are limited to the following exceptions:
 1. Global points such as outdoor air temperature, building pressure.
 2. Requests sent from zones to systems or systems to plant, used to trigger equipment operation or reset setpoints.
 3. Mode information sent from zones to systems or systems to plant used to select or change operating logic.
 4. Notwithstanding these exceptions, all operations required to maintain a controlled variable at setpoint must still be performed entirely within a single controller.
3. Configure controllers for automatic safe restart after a loss of power:

- a. If programming is intact, the controller shall resume full operation without operator intervention. All monitored functions shall be updated.
- b. If battery backup has been exhausted or programming is lost for any reason, the controller shall automatically report this condition and prepare to receive a download over the network.
- c. The controller shall automatically reset its clock such that time dependent functions occur on schedule without a manual reset.
- d. The DDC Contractor shall pre-configure staggered start such that the startup surge or inrush current of each major piece of equipment (air handling unit, boiler plant, chiller plant, etc.) has time to resolve before the next start event.

3.10 TESTING AND COMMISSIONING

A. General

- 1. Perform tasks in the order outlined subject to direction of the General Contractor.
- 2. Notify the Owner Representative and the Engineer if jobsite circumstances, Project schedule, or General Contractor instructions require substantial deviation from this sequence of events.
- 3. DDC Contractor shall provide a qualified technician who shall execute all Functional Tests in the presence of the Owner Representative and the Engineer of Record.
- 4. All deficiencies identified shall be corrected and demonstrated to the Owner Representative after resolution for acceptance.

B. Test Forms

- 1. Point-to-Point Test Forms
- 2. Provide forms for all checks and tests
- 3. Point-to-Point (Pre-Functional) and Functional Test procedures and associated forms shall be prepared by owner representative or commissioning agent.
- 4. If there is no owner representative then DDC Contractor shall prepare forms to verify correct execution of Sequences of Operations logic and correct operation of all alarms, interlocks, and schedules without compromising system integrity or damaging any piece of equipment.

5. Each form shall have a header or footer where the technician performing the test can indicate his/her name and the date of the test.
6. All forms shall be provided in digital format.
7. Test and Balance forms shall be provided by Test and Balance (TAB) Contractor.

C. Point-to-Point Tests

1. Inspect the installation of all devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.
2. Ensure devices are properly installed with adequate clearance for maintenance.
3. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in raceway.
4. Verify that all sensor locations are as indicated on drawings and are away from heat sources and other causes of erratic operation.
5. For each controller, perform Point Verifications and Point-to-Point Tests
 - a. Binary Outputs:
 1. Verify proper installation
 2. Verify correct normal position
 3. Verify correct response to command including parity of response (i.e. verify that a command OFF turns equipment off and not on).
 - b. Binary Inputs:
 1. Verify proper installation
 2. Verify signal from device maps to correct signal at graphical interface.
 3. Verify input signal thresholds are correct
 - c. Analog Outputs
 1. Verify proper installation
 2. Verify correct normal position.

- a. Test all fail-safe actuators by disconnecting power and verifying direction of travel.
- 3. Verify correct response to command including direction of movement.
- 4. Verify correct start and span (maximum and minimum stroke)
 - a. Verify that all automatic valves and dampers close completely upon a closed command. Adjust valve stem and damper blade travel as required.
 - b. Verify/adjust output range for points sending commands (e.g. setpoint) to other equipment.
- d. Analog Inputs
 - 1. Verify installation of sensors.
 - 2. Verify correct signal and mapping at graphical interface.
 - 3. Calibrate sensors that require field calibration, if any, as note on points list on Building Automation drawings or specifically listed elsewhere in this specification section.
 - a. Adjust calibrating parameters in software (such as slope and intercept) as required.
 - b. A calibration log shall be kept and initialed by the technician indicating date and time, sensor and handheld readings, and calibration constant adjustments and included in the Pre-functional Test Report.
 - c. Inaccurate sensors must be replaced if calibration is not possible.
- 6. User Interface Checks
 - a. All user interface elements and graphics are functional.
 - b. Graphics are properly bound to physical devices or virtual points.
 - c. Links and page jumps are functional and logical.
 - d. Events and alarms are annunciated timely
- 7. Point-to-Point Test Report

- a. Document results on forms and submit for approval as Point-to-Point Test report.
- b. Point-to-point tests must be performed and documented for every individual point in the system. Testing a sample or subset of points shall not be acceptable. The Point-to-Point report shall not be accepted, nor shall further work be authorized, until all point-to-point tests have been completed to the satisfaction of the Engineer of Record and Owners Representative.

D. Test and Balance

1. Coordinate with Work performed under Division 23 Test and Balance (TAB). DDC Contractor shall support TAB Contractor in execution of tests that require interaction with or overrides of the DDC System.
2. Provide informal training of (1) hour to TAB contractor foreman and subordinate with the purpose of allowing them to navigate and adjust all hardware and software necessary to perform their scope autonomously.
3. Software shall be provided to TAB Contractor free of charge on a temporary basis to allow calibration of non-zone equipment controls and other Work specified under Division 23 TAB.
4. All zone equipment TAB Contractor shall use T-Stat for balancing.

E. Functional Tests

1. Functional Tests shall test all control logic in a formal manner to verify that Sequences of Operation were programmed accurately and provide the intended system behavior. Owner representative and Engineer of Record will witness these tests.
2. Each functional test shall consist of a series of defined steps.
 - a. For each step, test form shall include descriptions of an action/override to initiate the step and the expected system response.
 - b. For each step, technician performing test shall record actual system response and any notes or comments.
 - c. Expected response and actual response shall be described qualitatively (e.g. "fan speed increases") or quantitatively (e.g. "setpoint increases by 1.5°F") as appropriate.
 - d. Technician shall describe all observed responses. Where quantitative results are expected, technician shall record specific values observed.

3. Testing schedule shall be coordinated with Owner's Representative, commissioning agent and Engineer of Record.
4. All accepted Functional Tests shall be conducted by the DDC Contractor with results confirmed and signed by the Contractor's technician.
5. Functional Test Report
 - a. After submitted test forms and trends have been accepted, DDC Contractor shall perform all listed tests, take corrective action as required for failed tests, and repeat tests until a passing condition is obtained.
 - b. Document results on forms and submit digitally for approval as Functional Test report.

F. Remedial Work

1. Failed demonstration tests will require any remedial work at no additional cost to owner.
2. It is possible that deficiencies in the trades of others can be uncovered through course of Division 23 functional testing. Such deficiencies to be corrected at the expense of the associated trade and compensation for troubleshooting, diagnosing and retesting on the part of the DDC contractor to be back charged to the offending trade.

3.11 TRAINING

- A. *Include 8 hours total of on-site training* to assist personnel in becoming familiar with sitespecific issues, systems, Sequences of Operations, etc.
- B. Training Schedule
 1. Schedule training to provide Owner with at least 10 business days advance notice.
 2. Training shall occur within normal business hours at a mutually agreed on time. Unless otherwise agreed to, training shall occur Monday through Friday, except on U.S. Federal holidays.
 3. Training shall be on site.
- C. Attendance Tracking
 1. Circulate sign-in sheet at beginning of each session and solicit attendees to sign/initial.

D. Off-Site Primary/Factory System Training

1. Factory training is not required.

E. Regular Operators shall be trained to perform the following tasks:

1. Understand control system architecture and configuration
2. BMS Control system components
3. Understand system operation and Sequences of Operations
4. Operate the workstation and peripherals
5. Log on and off the system
6. Access graphics, point reports, and logs
7. Adjust and change system set points, time schedules, and holiday schedules
8. Understand and acknowledge alarms
9. Understand system drawings, and Operation and Maintenance manual
10. Understand the Project layout and location of control components
11. Print reports
12. Export trends

F. Training Materials

1. Present 1 hard copy of the approved submittals and as-builts as described above.
2. Provide each attendee with a color hard copy of all training materials and visual presentations.
3. Hard-copy materials shall be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
4. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of all hard-copy materials.

END OF SECTION

SECTION 23 54 16.13

Gas-Fired Furnaces

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Gas-fired, non-condensing furnaces and accessories complete with controls.
 - 2. Air filters.
 - 3. Evaporator Coils.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
 - 1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each furnace to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Div 01 "Operation and Maintenance Data,"

include the following:

- a. Furnace and accessories complete with controls.
- b. Air filter.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Disposable Air Filters: Furnish two complete sets.
 - 2. Fan Belts: Furnish one set(s) for each furnace fan.

1.7 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- B. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- C. Comply with NFPA 70.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace the following components of furnaces that fail in materials or workmanship within specified warranty period:
 - 1. Warranty Period, Commencing on Date of Substantial Completion:
 - a. Furnace Heat Exchanger: 10 years .
 - b. Integrated Ignition and Blower Control Circuit Board: 5 years.
 - c. Evaporator and Condenser Coils: 5 years.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a qualified testing agency, and marked for intended

location and application.

- B. General Requirements for Noncondensing Gas-Fired Furnaces: Factory assembled, piped, wired, and tested; complying with ANSI Z21.47/CSA 2.3 and NFPA 54.

2.2 GAS-FIRED FURNACES, CONDENSING

- A. See the mechanical drawings equipment schedule for specifications.

2.3 EVAPORATOR COIL

- A. See the mechanical drawings equipment schedule for specifications.

2.4 AIR FILTERS

- A. See the mechanical drawings equipment schedule for specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine factory-installed insulation before furnace installation. Reject units that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for gas and refrigerant piping systems to verify actual locations of piping connections before equipment installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install gas-fired furnaces and associated fuel and vent features and systems according to NFPA 54.
- B. Base-Mounted Units: Secure units to substrate. Provide optional bottom closure base if required by installation conditions.
 - 1. Anchor furnace to substrate to resist code-required seismic acceleration.
- C. Controls: Install thermostats at mounting heights indicated in drawings above

floor.

- D. Wiring Method: Install control wiring in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal control wiring except in unfinished spaces.

3.3 CONNECTIONS

- A. Gas piping installation - Drawings indicate general arrangement of piping, fittings, and specialties. Connect gas piping with union or flange and appliance connector valve.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Vent Connection, Noncondensing, Gas-Fired Furnaces: Connect Type B vents to furnace vent connection and extend outdoors. Type B vents per installation requirements.
 - 1. Slope pipe vent back to furnace or to outside terminal.
- D. Connect ducts to furnace with flexible connector. Comply with requirements in Section 233300 "Heating, Ventilation, and Air Conditioning ."
- E. Connect refrigerant tubing kits to refrigerant coil in furnace and to air-cooled compressor/condenser unit.
 - 1. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- F. Comply with requirements in Section 23 00 00 Heating, Ventilation, and Air Conditioning for refrigerant Piping installation and joint construction of refrigerant piping.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Perform electrical test and visual and mechanical inspection.
 - 2. Leak Test: After installation, charge systems with refrigerant and test for leaks. Repair leaks, replace lost refrigerant, and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.

4. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

3.5 STARTUP SERVICE

- A. Engage a factory -authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
1. Inspect for physical damage to unit casings.
 2. Verify that access doors move freely and are weathertight.
 3. Clean units and inspect for construction debris.
 4. Verify that all bolts and screws are tight.
 5. Adjust vibration isolation and flexible connections.
 6. Verify that controls are connected and operational.
- C. Adjust fan belts to proper alignment and tension.
- D. Start unit according to manufacturer's written instructions and complete manufacturer's operational checklist.
- E. Measure and record airflows.
- F. Verify proper operation of capacity control device.
- G. After startup and performance test, lubricate bearings and adjust belt tension.

3.6 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set controls, burner, and other adjustments for optimum heating performance and efficiency. Adjust heat-distribution features, including shutters, dampers, and relays, to provide optimum heating performance and system efficiency.

3.7 CLEANING

- A. After completing installation, clean furnaces internally according to manufacturer's written instructions.
- B. Install new filters in each furnace within 14 days after Substantial Completion.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain condensing units. Refer to Div 01 "Demonstration and Training."

END OF SECTION

SECTION 23 81 26

Split System Air Conditioners

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Air-cooled refrigerant condensers and fan coil units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details,

drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
 2. Structural members to which air cooled condensing units and fan coil units will be attached.
 3. Method of attaching hangers to building structure.
 4. Liquid and vapor pipe sizes.
 5. Refrigerant specialties.
 6. Evaporators.
 7. Piping including connections, oil traps, and double risers.
 8. Size and location of initial access modules for acoustical tile.
 9. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 10. Perimeter moldings.
- B. Seismic Qualification Certificates: For air cooled condensing units, fan coil units, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set(s) for each air-handling unit.
 - 2. Fan Belts: One set(s) for each air-handling unit fan.

1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.9 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

- a. For Compressor: Ten year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Carrier
- B. Or approved equal.

2.2 OUTDOOR CONDENSING UNITS

- A. See the mechanical drawings equipment schedule for specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Equipment Mounting:
1. Comply with requirements for vibration isolation and seismic control devices per drawings.
- D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative

to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 81 26

SECTION 26 01 00

BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The requirements of the General Conditions and Division 1, General Requirements, apply to the work specified in this section.

1.2 DESCRIPTION OF WORK

- A. Related Work in Other Sections, but not limited to the following:
 - 1. Motors, motor controls and low voltage control wiring that are an integral part of equipment assemblies and heating and ventilation controls.
 - 2. Painting of exposed electrical work.
- B. Work Included in Contract
 - 1. Replace electrical components and connect electrical connections to new HVAC units.
 - 2. Replace electrical receptacles and condensate pump connections as indicated on plans.
 - 3. Grounding and bonding per NEC.
 - 4. Upgrade existing fire alarm control panel and provide new heat detectors as shown on plans and per specifications.
 - 5. Provide wiring and hookup of all electrical equipment specified under other specification sections, such as mechanical equipment.

1.3 CODES AND STANDARDS

- A. In addition to Codes and Standards - Division 1, the following shall apply to this Division:

National Electrical Code with California amendments
California Admin. Code, Titles 17, 19, 24, Part 3.
U.L. Electrical Construction Materials List
Codes, rules and regulations as specified hereinafter

1.4 SUBMITTALS

- A. Submittals shall be made in conformance with the General Conditions. The list shall include, for each item, the manufacturer, manufacturer's catalog number, type of class, the rating, capacity, size, etc. Submittals shall include:
 - 1. Conduit & Fittings
 - 2. Boxes & Covers
 - 3. Fuses
 - 4. Wire & Cable
 - 5. Wiring Devices
 - 6. Disconnect Switches
 - 7. Fire Alarm System
- B. Shop Drawings: Submit for approval, detailed construction drawings for each item of fabricated equipment required for the electrical installation. All drawings shall be to scale, fully dimensioned, and provide sufficient detail to clearly indicate the arrangement of the equipment and its component parts. Construction of the equipment shown shall be revised to comply with the drawings and specifications as required by the Architect after review of the shop drawings, and the drawings submitted when requested by the Architect. Shop drawings shall be submitted for the following:
 - 1. Fire Alarm System
- C. Substitution: Provide substitutions as outlined.

1.5 SUPERVISION OF ELECTRICAL WORK

- A. Contractor shall personally, or through an authorized and competent representative, constantly supervise the work from beginning to completion and final acceptance. So far as possible, keep same foreman and workmen throughout the project duration. Work shall be subject to inspection and approval by Architect. Promptly furnish related information when so requested by Architect.

1.6 EQUIPMENT AND SYSTEMS IDENTIFICATION

- A. Name Plates: Provide permanent identification of circuit breakers in switchboards, panels, transformers, disconnects for mechanical and plumbing roof-top equipment and other cabinet enclosed apparatus. Use black bakelite plates, not less than ½" X 3", with engraved white letters, secured with adhesive. Provide voltage along with panel name. Provide red with white letters on FACP, FATC, etc.
- B. Stencil Work: Identify all motors and operating apparatus in electrical equipment rooms or semi-concealed spaces, with black or white lacquer lettering, not less than ½" high, placed where readily visible upon inspection.
- C. Directories: Provide for power circuits, typewritten, neatly arranged in numerical order, and permanently fixed inside or adjacent to appropriate panel.
- D. Provide lamecoid label on all receptacle and switch covers indicating complete circuit number.
- E. Provide service description etched on cover of all underground pull boxes.
- F. Provide lamecoid label on all receptacle and switch covers indicating complete circuit number.
- G. Provide lamecoid label on all blank cover plates indicating circuit number or low voltage system (i.e. future data, intrusion, etc.).
- H. Provide lamecoid label on all fire alarm device covers indicating complete device number.

1.7 OPERATING INSTRUCTIONS ON-SITE

- A. At time of occupancy, arrange for manufacturer's representatives to instruct building operating and maintenance personnel in use of any equipment requiring operating and maintenance. Arrange for all personnel to be instructed at one time. Pay all costs for such service (minimum of 4 hours).

1.8 ADJACENT WORK

- A. Coordinate work and complete with others in furnishing and placing this work.
- B. Work to approved shop drawings for work by others and to field measurements as necessary to properly fit the work.
- C. Project adjacent work as necessary; adjacent construction or exposed surfaces or surfaces damaged by use of materials or operations under this Section shall be repaired or replaced as directed by Architect.

1.9 DRAWINGS

- A. The electrical drawings, which constitute an integral part of this contract, shall serve as the working drawings. They indicate diagrammatically the general layout of the complete electrical system, including the arrangement of feeders, circuits, panelboards, service equipment, and other work. Field verifications of scale dimensions taken from the drawings are directed since actual field locations, distances and elevations will be governed by actual field conditions. Review architectural, structural, mechanical and plumbing drawings and adjust work to conform to all conditions indicated thereon. Discrepancies shown on different plans or between plans and actual field conditions, or between plans and specifications, shall promptly be brought to the attention of the Architect for a decision.

1.10 COORDINATION AND COOPERATION

- A. Drawings and specifications are both supplementary and complementary. Taken together, they are intended to define complete working installations of the systems represented, in accordance with approved practice in the trade, and in conformity with all applicable requirements of local jurisdictional offices and officers and codes and enforcing bodies.
- B. It shall be presumed that any bid offered under this Division of the Specifications is based on a careful examination of the job site, and of the plans and specifications; that the person(s) or firm(s) awarded a contract hereunder is/are experienced and qualified in the type of work represented; that every effort has been made to prepare complete, accurate and correct plans and specifications; and that reasonable diligence will be exercised in planning and scheduling the work to anticipate conflicts and/or detect errors or omissions. All such shall be immediately reported, and proper resolution agreed on between concerned parties before the work affected is performed. If due to lack of diligence, or to incompetence, failure to anticipate such problems shall not create a valid claim for extra costs or charges.
- C. Requirements of other trades, of utility companies, and of fire departments, protective services, communication systems, or other facilities of a utility nature, shall be determined prior to installation of systems, equipment, devices or materials affected by or dependent on such requirements.
- D. Unapproved deviations or changes based on a presumption of error or code violation, or work not suitable for its intended function, may not be accepted.
- E. Nothing herein shall act to prevent or discourage the contractor from suggesting or discussing possible changes in the work where such might be beneficial to the contractor or the owner, or might facilitate the work of this or other trades.

- F. Any work resulting in a claim for a change in the contract price must be approved and fully documented.

1.11 VISIT TO SITE

- A. Visit the project site, take requisite measurements, and verify exact location of buildings, utilities, and other facilities, and obtain such other information as is necessary for an intelligent bid. No allowance will subsequently be made by the Architect or Owner for any error or omission on the part of the bidder in this connection.

1.12 RECORD DRAWINGS

- A. Record of Job Progress: Keep an accurate dimensional record of the "as-built" locations and of all work; all as required. This record shall be kept up-to-date on blue-line prints as the job progresses and shall be available for inspection at all times. It shall be reviewed by inspector prior to each monthly application for payment.
- B. Record of Installation: Refer to Supplementary General Conditions.
- C. Include on "as-built" drawings:
 - 1. Routing of all buried or concealed electrical feeders and conduits.
- D. Upon completion of the work, a completed set of as-built reproducible vellums and electronic file (ACAD 2004) on Cd/DVD disk(s) shall be delivered to the Architect.

1.13 GUARANTEE

- A. All work shall be guaranteed for a minimum period of one year from either the official date of completion or from the date of acceptance by the Owner, whichever is the later date. The guarantee period for certain items shall be longer, as indicated in the specification for those items.
- B. Should any trouble develop during the guarantee time due to defective material, faulty workmanship, or non-compliance with plans, specifications, codes or directions of the Owner, Architect, Engineer or Inspector, the Contractor shall furnish all necessary labor and materials to correct the trouble without additional charges.

1.14 COMMISSIONING

- A. Electrical systems including lighting and lighting controls, occupancy sensors, daylight controls, switching systems, exterior lighting controls and uninterruptible power supplies will be commissioned per the requirements specified in Commissioning Requirements.”

END OF SECTION

SECTION 26 05 00

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Electrical identification.
 - 2. Concrete equipment bases.
 - 3. Electrical demolition.
 - 4. Cutting and patching for electrical construction.

1.2 SUBMITTALS

- A. Product Data: For utility company electricity-metering components.
- B. Shop Drawings: Dimensioned plans and sections or elevation layouts and single-line diagram of electricity-metering component assemblies specific to this Project.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

1.4 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings for electrical supports, raceways, and cable with general construction work.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment that requires positioning before closing in the building.
- C. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.
- D. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel: Flange edges turned toward web, and 9/16-inch-diameter slotted holes at a maximum of 2 inches o.c., in webs. Strength rating to suit structural loading.
- D. Slotted Channel Fittings and Accessories: Recommended by the manufacturer for use with the type and size of channel with which used.
 - 1. Materials: Same as channels and angles, except metal items may be stainless steel.
- E. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- G. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
- H. Expansion Anchors: Carbon-steel wedge or sleeve type.
- I. Toggle Bolts: All-steel springhead type.
- J. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 ELECTRICAL IDENTIFICATION

- A. Identification Device Colors: Use those prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick.
- C. Tape Markers for Conductors: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- D. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.

- E. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape compounded for permanent direct-burial service, and with the following features:
 - 1. Not less than 6 inches wide by 4 mils thick.
 - 2. Embedded continuous metallic strip or core.
 - 3. Printed legend that indicates type of underground line.
- F. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.
- G. Warning and Caution Signs: Preprinted; comply with 29 CFR 1910.145, Chapter XVII. Colors, legend, and size appropriate to each application.
 - 1. Interior Units: Aluminum, baked-enamel-finish, punched or drilled for mechanical fasteners.
 - 2. Exterior Units: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate with 0.0396-inch, galvanized-steel backing. 1/4-inch grommets in corners for mounting.
- H. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.3 CONCRETE BASES

- A. Concrete Forms and Reinforcement Materials: As specified in Division 3 Section "Cast-in-Place Concrete."
- B. Concrete: 3000-psi, 28-day compressive strength.

2.4 CONCRETE BOXES

- A. Concrete Boxes: Pre-cast reinforced, size and type as shown; Christy, Brooks or approved equal. All underground boxes shall be provided with traffic grade, spring loaded, bolt-down, steel cover.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom.

- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, slotted channel system components.
- B. Dry Locations: Steel materials.
- C. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four with, 200-lb minimum design load for each support element.

3.3 SUPPORT INSTALLATION

- A. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- B. Size supports for multiple raceway or cable runs so capacity can be increased by a 25 percent minimum in the future.
- C. Support individual horizontal single raceways with separate, malleable-iron pipe hangers or clamps except use spring-steel fasteners for 1-1/2-inch and smaller single raceways above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- D. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- E. Secure electrical items and their supports to building structure, using the following methods unless other fastening methods are indicated:
 - 1. Wood: Wood screws or screw-type nails.
 - 2. Gypsum Board: Toggle bolts. Seal around sleeves with joint compound, both sides of wall.
 - 3. Masonry: Toggle bolts on hollow block and expansion bolts on solid block. Seal around sleeves with mortar, both sides of wall.

4. New Concrete: Concrete inserts with machine screws and bolts.
5. Existing Concrete: Expansion bolts.
6. Structural Steel: Spring-tension clamps.
 - a. Comply with AWS D1.1 for field welding.
7. Light Steel Framing: Sheet metal screws.
8. Fasteners for Damp, Wet, or Weather-Exposed Locations: Stainless steel.
9. Light Steel: Sheet-metal screws.
10. Fasteners: Select so load applied to each fastener does not exceed 25 percent of its proof-test load.

3.4 IDENTIFICATION MATERIALS AND DEVICES

- A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.
- C. Self-Adhesive Identification Products: Clean surfaces before applying.
- D. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.
- E. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches, overall, use a single line marker.
- F. Install warning, caution, and instruction signs where required to comply with 29 CFR 1910.145, Chapter XVII, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Indoors install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
- G. Install, where applicable, engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

- H. Provide service description etched on cover of all underground pull boxes.

3.5 FIRESTOPPING

- A. Apply firestopping to cable and raceway sleeves and other penetrations of fire-rated floor and wall assemblies to restore original undisturbed fire-resistance ratings of assemblies. Firestopping installation is specified in Division 7 Section "Through-Penetration Firestop Systems."

3.6 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated.

3.7 DEMOLITION

- A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.
- D. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.8 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair, refinish and touch up disturbed finish materials and other surfaces to match adjacent undisturbed surfaces.

END OF SECTION

SECTION 26 05 19

CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.2 SUBMITTALS

- A. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 CONDUCTORS AND CABLES

- A. Manufacturers:
 - 1. Alcan Aluminum Corporation; Alcan Cable Div.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. General Cable Corporation.
 - 4. Senator Wire & Cable Company.
 - 5. Southwire Company.
- B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.
- C. Conductor Material: Copper complying with NEMA WC 5 or 7; solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.

- D. Conductor Insulation Types: Type THW, THHN-THWN or XHHW complying with NEMA WC 5 or 7.

2.3 CONNECTORS AND SPLICES

- A. Manufacturers:
 - 1. AMP Incorporated/Tyco International.
 - 2. Hubbell/Anderson.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M Company; Electrical Products Division.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway .
- C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspace: Type THHN-THWN, single conductors in raceway.
- E. Exposed Branch Circuits, including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.
- I. Fire Alarm Circuits: Type THHN-THWN, in raceway.
- J. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- K. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.2 INSTALLATION

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed feeders parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26.
- F. Seal around cables penetrating fire-rated elements according to Section "Through-Penetration Firestop Systems."
- G. Identify and color-code conductors and cables according to Division 26 Section "Basic Electrical Materials and Methods."
- H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- I. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.3 FIELD QUALITY CONTROL

- A. Testing: Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.
- B. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Requirements specified in this Section may be supplemented by requirements of other Sections.

1.2 SUBMITTALS

- A. Product Data: For ground rods.
- B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled under UL 467 as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Boggs, Inc.
 - 2. Copperweld Corp.
 - 3. Dossert Corp.
 - 4. Erico Inc.; Electrical Products Group.
 - 5. Galvan Industries, Inc.
 - 6. Harger Lightning Protection, Inc.
 - 7. Hastings Fiber Glass Products, Inc.
 - 8. Heary Brothers Lightning Protection Co.
 - 9. ILSCO.
 - 10. Kearney/Cooper Power Systems.
 - 11. Korns, C. C. Co.; Division of Robroy Industries.

12. Lightning Master Corp.
13. Lyncole XIT Grounding.
14. O-Z/Gedney Co.; a business of the EGS Electrical Group.
15. Robbins Lightning, Inc.
16. Salisbury, W. H. & Co.
17. Superior Grounding Systems, Inc.
18. Thomas & Betts, Electrical.

2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."
- B. Equipment Grounding Conductors: Insulated with green-colored insulation.
- C. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- D. Grounding Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- F. Bare, Solid-Copper Conductors: ASTM B 3.
- G. Assembly of Bare, Stranded-Copper Conductors: ASTM B 8.
- H. Bare, Tinned-Copper Conductors: ASTM B 33.
- I. Copper Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
- J. Copper Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- K. Tinned-Copper Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- L. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulated spacer.
- M. Connectors: Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items. Exothermic-welded type, in kit form, selected per manufacturer's written instructions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.

1. Size: 3/4 inches in diameter by 120 inches long.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections.

D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
2. At doors, route the bus up to the top of the door frame, across the top of the doorway, and down to the indicated height above the floor.

E. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

F. Equipment Grounding Conductors: Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

1. Install insulated equipment grounding conductors in feeders.
2. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
3. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
4. Air-Duct Equipment Circuits: Install an insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and

- more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
5. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install an insulated equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
 6. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location and per Division 27.
 - a. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a grounding bus per Division 27.
 - b. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
 7. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing an insulated equipment grounding conductor with supply branch-circuit conductors.
- G. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- H. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- I. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers or supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- J. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a

dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

- K. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- L. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- M. Connections: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
 - 6. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
 - 7. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
 - 8. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
 - 9. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

10. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
 11. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.
- N. Manholes and Handholes: Install a driven ground rod close to wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- O. Connections to Manhole Components: Connect exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

3.2 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 2. Test completed grounding system at each location where a maximum ground-resistance level is indicated and at service disconnect enclosure grounding terminal. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
 3. Provide drawings locating each ground rod, ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of

weather and other phenomena that may affect test results. Describe measures taken to improve test results. Nominal maximum values are as follows:

- a. Equipment Rated 500 kVA and Less: 10 ohms.
- b. Equipment Rated 500 to 1000 kVA: 5 ohms.
- c. Equipment Rated More Than 1000 kVA: 3 ohms.
- d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
- e. Manhole Grounds: 10 ohms.

END OF SECTION

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SECTION 26 05 29

SEISMIC CONTROLS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes seismic restraints and other earthquake-damage-reduction measures for electrical components. It applies to and complements optional seismic-restraint requirements in the various electrical component Sections of these Specifications.

1.2 DEFINITIONS

- A. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.
- B. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independently of other structural elements during an earthquake.

1.3 SUBMITTALS

- A. Product Data: Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of seismic-restraint component used. Include documentation of evaluation and approval of components by agencies acceptable to authorities having jurisdiction.
- B. Shop Drawings: For components, physical arrangements, and installation details not defined by Drawings. Indicate materials and show calculations, design analysis, details, and layouts, signed and sealed by a professional engineer.
- C. Pre-approval and Evaluation Documentation: By an agency approved by authorities having jurisdiction, showing maximum ratings of restraints.
- D. Qualification data.
- E. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in California Building Code, unless requirements in this Section are more stringent.

- B. Testing Agency Qualifications: An independent testing and inspection agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the inspection indicated.

1.5 PROJECT CONDITIONS

- A. Project Seismic Zone and Zone Factor as Defined in CBC.

1.6 COORDINATION

- A. Coordinate layout and installation of seismic bracing with building structure, architectural features, and mechanical, fire-protection, electrical, and other building systems.
- B. Coordinate concrete bases with building structural system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. B-Line Systems, Inc.
 - 3. Erico, Inc.
 - 4. GS Metals Corp.
 - 5. Loos & Company, Inc.
 - 6. Mason Industries, Inc,
 - 7. Powerstrut.
 - 8. Thomas & Betts Corp.
 - 9. Unistrut Corporation.

2.2 MATERIALS

- A. Use the following materials for restraints:
 - 1. Indoor Dry Locations: Steel, zinc plated.
 - 2. Outdoors and Damp Locations: Galvanized steel.
 - 3. Corrosive Locations: Stainless steel.

2.3 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

- A. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Strength in tension and shear of components shall be at least twice the maximum seismic forces for which they are required to be designed.
- B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.
- C. Concrete Inserts: Steel-channel type.
- D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
- E. Welding Lugs: Comply with MSS SP-69, Type 57.
- F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.
- G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.4 SEISMIC-BRACING COMPONENTS

- A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch-thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.
 - 1. Materials for Channel: ASTM A 570, GR 33.
 - 2. Materials for Fittings and Accessories: ASTM A 575, ASTM A 576, or ASTM A 36.
 - 3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
 - 4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.
- B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.
- C. Hanger Rod Stiffeners: Slotted steel channels, installed vertically, with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install seismic restraints according to applicable codes and regulations and as approved by authorities having jurisdiction, unless more stringent requirements are indicated.
- B. Install structural attachments as follows:
 - 1. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses.
 - 2. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.
 - 3. Attachments to Existing Concrete: Use expansion anchors.
 - 4. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.
 - 5. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.
 - 6. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.
 - 7. Attachments to Wood Structural Members: Install bolts through members.
 - 8. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.
- C. Install electrical equipment anchorage as follows:
 - 1. Anchor panelboards, motor-control centers, motor controls, switchboards, transformers, fused power-circuit devices, control, and distribution units as follows:
 - a. Anchor equipment rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.
 - b. Size concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.
 - c. Bushings for Floor-Mounted Equipment Anchors: Install to allow for resilient media between anchor bolt or stud and mounting hole in concrete.
 - d. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.

- e. Torque bolts and nuts on studs to values recommended by equipment manufacturer.
- D. Install seismic bracing as follows:
 - 1. Install bracing according to spacings and strengths indicated by approved analysis.
 - 2. Expansion and Contraction: Install to allow for thermal movement of braced components.
 - 3. Attachment to Structure: If specific attachment is not indicated, anchor bracing to the structure at flanges of beams, upper truss chords of bar joists, or at concrete members.
- E. Accommodation of Differential Seismic Motion: Make flexible connections in raceways, cables, wireway, cable trays, and busway where they cross expansion- and seismic-control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate at electrical equipment anchored to a different mobile structural element from the one supporting them.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspection agency to inspect seismic-control installation for compliance with indicated requirements.
- B. Testing Agency: Engage a qualified testing and inspection agency to inspect seismic-control installation for compliance with indicated requirements.
- C. Reinspection: Correct deficiencies and verify by reinspection that work complies with requirements.
- D. Provide written report of tests and inspections.

END OF SECTION

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SECTION 26 13 00

RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets indicated.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 METAL CONDUIT AND TUBING

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc.
 - 2. Alfex Inc.
 - 3. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 4. Electri-Flex Co.
 - 5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
 - 6. LTV Steel Tubular Products Company.
 - 7. Manhattan/CDT/Cole-Flex.

- 8. O-Z Gedney; Unit of General Signal.
- 9. Wheatland Tube Co.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Aluminum Rigid Conduit: ANSI C80.5.
- D. IMC: ANSI C80.6.
- E. EMT and Fittings: ANSI C80.3.
 - 1. Fittings: Compression type.
- F. FMC: Aluminum.
- G. LFMC: Flexible steel conduit with PVC jacket.
- H. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers:
 - 1. American International.
 - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 3. Arnco Corp.
 - 4. Cantex Inc.
 - 5. Certainteed Corp.; Pipe & Plastics Group.
 - 6. Condux International.
 - 7. ElecSYS, Inc.
 - 8. Electri-Flex Co.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Manhattan/CDT/Cole-Flex.
 - 11. RACO; Division of Hubbell, Inc.
 - 12. Spiralduct, Inc./AFC Cable Systems, Inc.
 - 13. Thomas & Betts Corporation.
- B. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.
- C. RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

2.4 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
 - 1. Manufacturers:
 - a. Airey-Thompson Sentinel Lighting; Wiremold Company (The).
 - b. Thomas & Betts Corporation.
 - c. Walker Systems, Inc.; Wiremold Company (The).
 - d. Wiremold Company (The); Electrical Sales Division.
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.
 - 1. Manufacturers:
 - a. Butler Manufacturing Co.; Walker Division.
 - b. Enduro Composite Systems.
 - c. Hubbell, Inc.; Wiring Device Division.
 - d. Lamson & Sessions; Carlon Electrical Products.
 - e. Panduit Corp.
 - f. Walker Systems, Inc.; Wiremold Company (The).
 - g. Wiremold Company (The); Electrical Sales Division.
- C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. Emerson/General Signal; Appleton Electric Company.
 - 3. Erickson Electrical Equipment Co.
 - 4. Hoffman.
 - 5. Hubbell, Inc.; Killark Electric Manufacturing Co.
 - 6. O-Z/Gedney; Unit of General Signal.
 - 7. RACO; Division of Hubbell, Inc.

8. Robroy Industries, Inc.; Enclosure Division.

- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- H. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.
- I. Concrete Boxes: Pre-cast reinforced, size and type as shown; Christy, Brooks or approved equal. All underground boxes shall be provided with traffic grade, spring loaded, bolt-down, steel cover.

2.6 FACTORY FINISHES

- A. Finish: For raceway, enclosure, or cabinet components provide manufacturer's standard prime-coat finish ready for field painting.

2.7 FIRESTOPPING FOR LOW VOLTAGE SLEEVES

- A. Firestop Pillows: STI SpecSeal® Brand re-enterable, non-curing, mineral fiber core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag, the following products are acceptable:
 - 1. Specified Technologies Inc. (STI) SpecSeal® Series SSB Pillows.
- B. Fire Rated Cable Pathways: STI EZ-PATH™ Brand device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:
 - 1. Specified Technologies Inc. (STI) EZ-PATH™ Fire Rated Pathway.
 - 2. Specified Technologies Inc. (STI) Mini EZ-PATH™ Fire Rated Pathway.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:

1. Exposed: Rigid steel or IMC.
2. Concealed: Rigid steel or IMC.
3. Underground, Single Run: RNC.
4. Underground, Grouped: RNC.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R.
- 7. Underground duct bank conduit spacers.**
- 8. Backfill materials per civil site requirements.**

B. Indoors:

1. Exposed: EMT.
2. Concealed: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
4. Damp or Wet Locations: Rigid steel conduit.
5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
3. For Outdoor Use – conduit hub, NEMA 4 for conduit connection/terminating to cabinet/panel/boxes.

4. All connectors to be steel. Die cast connectors are not acceptable.

E. Do not install aluminum conduits embedded in or in contact with concrete.

3.2 INSTALLATION

A. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."

D. Install temporary closures to prevent foreign matter from entering raceways.

E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above finished slab.

F. Make bends and offsets so ID is not reduced. Keep legs of bends in same plane and keep straight legs of offsets parallel, unless otherwise indicated.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

1. Install concealed raceways with a minimum of bends in shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

H. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

2. Space raceways laterally to prevent voids in concrete.

3. Run conduit larger than 1-inch trade size parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

4. Change from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.

I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.

2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

- J. Join raceways with fittings designed and approved for that purpose and make joints tight.
 - 1. Use insulating bushings to protect conductors on all raceways 2" and larger.
- K. Tighten set screws of threadless fittings with suitable tools.
- L. Terminations:
 - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
 - 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- N. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
- O. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- P. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- Q. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration,

noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

R. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

S. Set floor boxes level and flush with finished floor surface.

T. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 22 00

FUSES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Cartridge fuses rated 600 V and less for use in switches controllers and motor-control centers.

1.2 SUBMITTALS

- A. Product Data: For each fuse type indicated.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NEMA FU 1.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussman, Inc.
 - 2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 FUSE APPLICATIONS

- A. Service Entrance: Class L, fast acting or J, fast acting.
- B. Motor Branch Circuits: Class RK5, time delay.

3.2 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.3 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Single and duplex receptacles, ground-fault circuit interrupters.
 - 2. Single- and double-pole snap switches and dimmer switches.
 - 3. Device wall plates.
 - 4. Floor service outlets, poke-through assemblies and multioutlet assemblies.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices:
 - a. Bryant Electric, Inc./Hubbell Subsidiary.
 - b. Eagle Electric Manufacturing Co., Inc.
 - c. Hubbell Incorporated; Wiring Device-Kellems.

- d. Leviton Mfg. Company Inc.
- e. Pass & Seymour/Legrand; Wiring Devices Div.
- 2. Multioutlet Assemblies:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Wiremold Company (The).
- 3. Poke-Through, Floor Service Outlets and Telephone/Power Poles:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Pass & Seymour/Legrand; Wiring Devices Div.
 - c. Square D/Groupe Schneider NA.
 - d. Thomas & Betts Corporation.
 - e. Wiremold Company (The).

2.2 RECEPTACLES

- A. Straight-Blade and Locking Receptacles: Heavy-Duty grade.
- B. Straight-Blade Receptacles: Hospital grade.
- C. GFCI Receptacles: Straight blade, non-feed-through type, Hospital or Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch deep outlet box without an adapter.

2.3 SWITCHES

- A. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.
- B. Snap Switches: Heavy-Duty grade, quiet type.
- C. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
 - 1. Switch: 20 A, 120/277-V ac.
 - 2. Receptacle: NEMA WD 6, Configuration 5-20R.

2.4 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces: 0.035-inch thick, satin-finished stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Wet Locations: Cast aluminum with spring-loaded, lockable, lift cover, and listed and labeled for use in "wet locations."

2.5 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular, solid brass with satin finish.
- D. Power Receptacle: NEMA WD 6, Configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: See telecommunication specifications for requirements.
- F. Wiremold RFB4-4DB series complete with brackets, devices, corresponding covers and hardware.

2.6 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
 1. Service Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks.
 2. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness.
 3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
 4. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.
 5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors; and a minimum of four, 4-pair, Category 6 voice and data communication cables.

2.7 MULTIOUTLET ASSEMBLIES

- A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

B. Raceway Material: PVC.

C. Wire: No. 12 AWG.

2.8 FINISHES

A. Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices and assemblies level, plumb, and square with building lines.
- B. Install wall dimmers to achieve indicated rating after derating for ganging.
- C. Install unshared neutral conductors on line and load side of dimmers.
- D. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.
- E. Remove wall plates and protect devices and assemblies during painting.
- F. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Basic Electrical Materials and Methods."
 1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.
 2. Submit same for approval.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
- B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
 1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.

2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION

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SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers.
 - 4. Enclosures.

1.2 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.

2. General Electric Co.; Electrical Distribution & Control Division.
 3. Siemens Energy & Automation, Inc.
 4. Square D/Group Schneider.
- B. Fusible Switch, 600 A and Smaller: NEMA KS 1, Type GD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Nonfusible Switch, 600 A and Smaller: NEMA KS 1, Type GD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- D. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
 3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open (required for all disconnects located downstream of Variable frequency Drives)

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

- A. Manufacturers:
1. Eaton Corporation; Cutler-Hammer Products.
 2. General Electric Co.; Electrical Distribution & Control Division.
 3. Siemens Energy & Automation, Inc.
 4. Square D/Group Schneider.
- B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.

4. GFCI Circuit Breakers: Single- and two-pole configurations with 30-mA trip sensitivity.
- C. Molded-Case Circuit-Breaker Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

2.4 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
1. Outdoor Locations: NEMA 250, Type 3R.
 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 26 Section "Basic Electrical Materials and Methods," and concrete materials and installation requirements are specified in Division 3.
- C. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- D. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- E. Comply with mounting and anchoring requirements specified in Division 26 Section "Seismic Controls for Electrical Work."
- F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

- G. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Basic Electrical Materials and Methods."

3.2 FIELD QUALITY CONTROL

- A. Prepare for acceptance testing as follows:
 - 1. Inspect mechanical and electrical connections.
 - 2. Verify switch and relay type and labeling verification.
 - 3. Verify rating of installed fuses.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION